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# The National Food Supply

IT will be a source of gratification to those who believe that the problem of the nutrition of their populations is worthy of serious consideration by responsible Governments, to be reminded that in Great Britain the Ministry of Health and the Scottish Office are instigating searching inquiries into the food supply of the nation as a whole and into the distribution of specially desirable foods among different sections of the community. Two years ago, these Government Departments appointed an Advisory Committee on Nutrition which included some senior civil servants from various Ministries and Departments, and some prominent scientific workers in the field of nutrition such as Prof. E. P. Cathcart, of the University of Glasgow, Sir Frederick Gowland Hopkins, of the University of Cambridge, Prof. E. Mellanby, secretary of the Medical Research Council, and Sir John Orr, director of the Rowett Research Institution, Aberdeen. Its terms of reference were : "to inquire into the facts, quantitative and qualitative, in relation to the diet of the people, and to report as to any changes therein which appear desirable in the light of modern advances in the knowledge of nutrition".

The Committee has now issued its first report*. It has had before it estimates of the total food consumed in recent years by the population of the United Kingdom, and was thus able to compare the quantities of food available with the nutritional requirements suggested in the report by the Technical Commission of the League of Nations Health Organisation, which is reprinted as an appendix to the present report. This comparison does not pretend to give an exact picture of the existing state of affairs ; nevertheless its results are of considerable interest. It is calculated that the national food supply, after allowing a margin of 10 per cent for wastage, contains more than sufficient calories to meet the energy requirements of the population on the basis of the report of the League Commission. It is the opinion of the Advisory Committee, therefore, that all except a small fraction of the population are getting as many calories as they require. There is no deficiency of fat in the national food supply, though there is some deficiency in the diet of the very poorest. The total amount of protein available for the population is sufficient to supply its needs, but seeing that the proportion of animal protein in the diet increases as the standard of living rises with income, it is considered probable that there is some shortage of animal protein in the diets of the poorest section of the community.

The greatest discrepancy between the estimates of national consumption and the recommendations of the League Commission relates to liquid milk. The requirements on the basis of the League Commission's report are estimated to be equivalent to an allowance of seven-eighths of a pint daily per head of the population, whereas the present actual consumption in the United Kingdom is less than half this amount. Even if the consumption of condensed and dried milk is taken into account, the total quantity works out at only 60 per cent of the Commission's recommendation.

This deficiency is regarded with special concern and is referred to again and again in the present report. The Advisory Committee published in 1936 a memorandum on the nutritive value of milk which is republished as an appendix to this report. In it the opinion is expressed that the desirable amount of milk for children is from one

* Ministry of Health. Advisory Committee on Nutrition. First Report. Pp. 52. (London : H.M. Stationery Office, 1937.) 1s. 0d. net.

to two pints a day, for expectant and nursing mothers about two pints a day and for other adult members of the community half a pint. The Committee deplores the fact that there is a deficiency of milk in the diet of large sections of the population at a time when there is a substantial surplus of liquid milk produced in the United Kingdom. The hope is expressed that the State will endeavour to ensure that a sufficient supply of safe milk will in the future be brought within the purchasing power of the poorest. It is considered that there is no other single measure which would do more to improve the health, development and resistance to disease of the rising generation than a largely increased consumption of safe milk by mothers, children and adolescents. While whole milk is a more complete food than other dairy products, the Committee would like to see skimmed milk and buttermilk more readily available for human consumption than they are at present.

With regard to other foods specially recommended by the League Commission, it has been possible in one or two instances to make comparisons between its recommendations and the actual consumption in the United Kingdom. The present average consumption of eggs is estimated to be 2·9 per head per week, while it is calculated that 3·9 per head per week would be necessary to satisfy the Commission's recommendation. The average weekly consumption of potatoes is in the region of 56 ounces per head; the Committee would like to see a larger consumption, to replace some of the sugar and highly milled cereal of the diet. It is pointed out that while sugar may be a useful source of energy, it possesses no other food value and, when taken in large amounts, it dulls the appetite for more valuable foods and may thus have an unfavourable effect on nutrition.

The recommendations which the Advisory Committee have made are based on experimental and medical data, which have already indicated the importance of good nutrition for the maintenance of health. It is admitted, however, that a great deal more information is necessary before a final verdict can be passed on the effect of good diets on the health of a community. The Committee has already proposed and instigated additional inquiries which should enable further practical suggestions to be made for improving the nutrition of the masses. It wishes, for example, to obtain a more reliable estimate than has hitherto been possible of the distribution of the population in income groups; it has invited Government Departments to undertake dietary surveys on a comprehensive scale and has recommended specifically that exact studies of the diets of several hundred families should be carried out in England, Scotland and Wales; it has also recorded its view that efforts should be continued to establish a reliable group of tests for the assessment of the state of nutrition of individual human beings.

Viscount Astor directed attention in the House of Lords on May 5 to the Advisory Committee's report, and obtained a statement given on behalf of the Government by Viscount Gage. Lord Gage said that the Government accepted the conclusions of the Committee, but thought that much more information is desirable; and the Government is prepared to collect it. A threefold inquiry is proposed. The Ministry of Labour will make an inquiry in connexion with the cost of living index figure. For this it is hoped to secure the weekly budgets of 10,000 families taken over four separate weeks in various parts of Great Britain. These results will be checked by another inquiry, called a qualitative dietary survey, of a much more detailed character. This is already in progress, and will eventually embrace 500 families, of which 200 may be from Scotland. Then, from the last census figures, a definite proportion, say, one in 500 or one in 1,000, of the family census schedules will be taken. Those are expected to show, roughly, after certain allowances are made for altered conditions, the distribution of the population according to occupation. These statistics will be compared with the information in the possession of the Ministry of Labour with regard to the wage rates current in such occupations. It is hoped that the statisticians will be able, on this basis, to correlate the results of these various inquiries and present a working analysis of how the incomes of the various classes of the community are divided with special reference to food.

What is not clear at the present moment is whether the Government only accepts the conclusions that the diet of the country is improving and that more data about this should be obtained, in which case a political gesture has been made to get over an embarrassing situation; or whether the main conclusions and recommendations have been accepted. If the Government has accepted these and intends to carry them out, then the new science of nutrition is about to be applied for the welfare of the people, and we are on the eve of what will be the greatest social reform of this century.

# The Ice Age in Detail

**The Quaternary Ice Age**
By W. B. Wright. Second edition. Pp. xxv + 478 + 23 plates. (London: Macmillan and Co., Ltd., 1937.) 25*s*. net.

WHEN the first edition of the "Quaternary Ice Age" was published in 1914, it took its place at once as the standard English text-book on the subject. Since then our ideas concerning the Glacial Period have undergone a profound change, for the monoglacial theory, after a comparatively brief tenure, has had to give place to the older view of successive ice-advances, alternating with milder, or even warm, interglacial episodes. A new and revised edition of this well-known book has, therefore, been looked forward to for some long time.

To review all the evidence that brought about such a change in ideas was indeed a formidable task, for mere revision of a text-book published in 1914 would obviously be inadequate. Nothing less than a largely rewritten edition would meet the case; and on the whole the author has accomplished this difficult task in an admirable manner. Of the 24 chapters of the second edition, only a few are reprinted in their original form; most have been expanded and brought up to date, and some are new. A considerable increase in size of the volume is the result; many new illustrations and the useful bibliographies now added to each chapter will be a great help to students.

The general chapters on glaciers and ice sheets, glacial deposits, theories of the Ice Age, the mammals of the time and earth movements during and since the Glacial Period remain much as in the earlier edition, but there are minor revisions. More attention has been given to the phenomena of glacial retreat, so clearly demonstrable in north-western Europe, and to the wind-borne loess, now believed to be intimately connected with the phenomena of ice-advance. But much rewriting has been necessary, because we now realize the inevitable effects on the contemporary fauna and flora of successive glaciations and interglacial phases—particularly as they affected the history of early man. As a result of this realization, geology and prehistoric archæology have become overlapped to such an extent that the glacialist, to be on safe ground, must be well versed in the study of prehistoric man, if not actually a specialist in that branch. A large mass of literature had, therefore, to be summarized in the preparation of this new edition, and the author has succeeded fairly well in his brave attempt.

The treatment of the details of the geology and archæology of the east of England gives the impression of being insecure and rather below the high standard of the rest of the work. A strange omission is that of the story of events in the valley of the Lower Thames (although a new chapter has been added on the river gravels of the south of England) from the deposits of which we have recently gained our most substantial knowledge of human occupation in relation to late glacial history (*vide* W. B. R. King and K. P. Oakley's useful summary and J. P. T. Burchell's work). Also, a few pages might have been spared for a review of the remarkable disturbances of soft strata, which, although they have given rise to much speculation and argument, have thrown valuable light on glacier-motion and the behaviour of englacial and subglacial material. These omissions, however, are but slight blemishes in a work which, taken as a whole, is a masterly summary of existing knowledge in a subject admittedly of wide range and crowded with detail. Mention only can be made, for example, of admirable chapters on the older and newer drifts of the British Isles, the glaciation of northern Europe, the Alps, and North America, and on raised beaches and submerged forests.

At the end of the volume are accounts of the author's isokinetic theory of oscillations of sea-level and of the post-glacial changes of climate in Europe. As the author regarded this theory as his most original contribution in the first edition of the book, it is perhaps only fair to quote his own words in the second edition: "...the demonstration that isostatic movement alone", that is, the reaction of the earth-crust to loading by and unloading from the ice-masses, "was an inadequate explanation of the quaternary oscillations of shore-line, but that it became completely adequate when coupled with eustatic change of ocean-level due to the return of the water bound up in the ice-sheets. This theory, which was then [in 1914] quite novel, has received ample confirmation from recent researches, and, being now completely established, is given the name Isokinetic, from the fact that shore-lines are cut when the two motions are equal and in the same sense".

A word of appreciation is due to the publishers for the obvious care taken in producing this handsome volume.

# An Advance in Kantian Scholarship

**Kant's Metaphysic of Experience:** a Commentary on the First Half of the "Kritik der reinen Vernunft". By Prof. H. J. Paton. (Library of Philosophy.) Vol. 1. Pp. 585. Vol. 2. Pp. 510. (London: George Allen and Unwin, Ltd., 1936.) 2 vols., 30*s*. net.

EVER since the philosophy of Immanuel Kant was given to the world, in the years 1781–90, there seems to have been a tacit understanding among his readers and commentators that this philosophy would not do as it stood; and thus there has grown up a curious but almost universal custom of reading Kant not for the sake of what he said, but for the sake of what the reader presumes that he ought to have meant. Idealist philosophers, including even the German neo-Kantians after Cohen, have rejected as 'dead' all elements in his philosophy except those which became a basis for the work of his idealist successors, and the first large-scale commentary on Kant that was produced in Great Britain was informed by the same assumption. More recent scholars have claimed to discover, with the aid of textual criticism, that the "Critique of Pure Reason" is a patchwork of fragments, written at different dates within a period of eleven years, embodying widely different and even contradictory views, and at last hastily assembled in the space of three months. On this view, Kant has no consistent philosophy of his own; his greatness rests merely upon the enormous width of his interests and the illuminating nature of many of his suggestions, but he involves himself in far more difficulties than he elucidates.

Prof. Paton's book represents the long-overdue reaction against these cavalier methods. Starting with the fact that the "Critique of Pure Reason", whatever its materials may have been, was obviously planned and executed as a whole, he examines and expounds in detail the text of the first two sections of it, the "Aesthetic" and the "Analytic", and discovers that it embodies a continuous and close-knit argument resting on certain assumptions which, whether true or not, are at any rate coherent, reasonable, and in no way idealistic. In these respects Prof. Paton's interpretation has the considerable merit of crediting Kant with having done very much what Kant himself always said he had done.

Two points in the author's interpretation of Kant call for special mention. The first is concerned with the doctrine of the thing in itself. To the scientific world, Kant has been known chiefly by what he has in common with Comte and Spencer. The sphere of possible knowledge, he says, is confined within the limits of experience, and the world which we know in experience is merely phenomenal. Behind the phenomenon lies the thing in itself, but that is and must always remain unknown. It is true that Kant also held doctrines of an absolute time and an absolute Euclidian space, and certain opinions about the nature of mathematical thinking, which have got him into trouble with mathematicians and physicists; but these are details, and the essence of his doctrine lies in distinguishing between phenomena and the thing in itself, and confining all possible knowledge to phenomena. Against this the philosophers have argued that, if the thing in itself is really unknown, Kant cannot even know that it exists, and is inconsistent in claiming to do so; that in the long run he is actually driven to admit that he is not certain of its existence, and that he ought to have denied it altogether and become a true idealist.

Prof. Paton shows in the work under notice that these criticisms are beside the mark. When Kant denies that we can know the thing in itself, he does not deny that we can form an idea of it as being something in general; what he denies is that we can have insight (*einsehen*) into its nature. Nor does he ever entertain a doubt of its existence; the passages which have been held to express such a doubt have been misinterpreted. Kant thinks it is quite certain that, behind the phenomena of Nature, there is something the existence of which we can recognize in a general sense, but the character of which we cannot conceive. This doctrine may be erroneous, but it is neither inconsistent nor *prima facie* unreasonable. That it is really Kant's doctrine was established by Adickes, to whose praise Prof. Paton consecrates a footnote; it has also been recognized by Dr. Ewing in his "Idealism", and it may be hoped that the recognition may become general.

The other point which requires special mention is Prof. Paton's treatment of Kant's doctrine of the schematism of the categories. The doctrine has been generally ignored, or treated as a piece of pedantry; but in fact it is indispensable to the coherence of Kant's argument. If the scientific worker, whose presuppositions Kant claims to be elucidating, is to recognize in Kant's categories his

own working principles, which are simply the minimum assumptions necessary in order to make sense of a world in space and time, then Kant himself must take explicit account of space and time, and see to it that any more abstract principles of his own, which he may be able to extract from an analysis of pure logical forms, shall be given a spatio-temporal form, that is, 'schematized', before he can set them forth as valid for scientific thought. Prof. Paton's understanding of this, and his demonstration that Kant also understood it, constitute not the least of the merits of this book.

Kant's philosophy does not lend itself to quick study and epigrammatic judgment; but those who are prepared to study it seriously and in detail, as it demands, will do well to take Prof. Paton as their guide. His commentary is indispensable to those who wish to obtain a clear and balanced view of the fundamental principles of one of the greatest philosophies of modern times.

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# Comparative Biochemistry

**An Introduction to Comparative Biochemistry** By Dr. Ernest Baldwin. Pp. xviii+112. (Cambridge: At the University Press, 1937.) 5*s.* net.

UNTIL recently, the criteria of zoological and botanical relationships were, in the main, qualities of external or internal structure, or of functional behaviour. The possibly more intimate and certainly less obvious resemblances and differences between different animal types, in the chemical make-up of their tissues and body fluids and in their metabolic habits, have only recently begun to come within the sphere of established knowledge. It is as a direct result of the new methods which have been developed in biochemistry, particularly as an outcome of increased accuracy in dealing analytically with very small quantities of material, that information has accumulated in the last few years regarding these matters, throwing a flood of light on the ways in which the physical and chemical problems presented to different types of living organisms at various stages in their evolutionary history have been overcome.

In this book an outline of recent advances in this relatively untrodden field—an outline that is never far from the available experimental findings—is presented in an admirably succinct way by Dr. Baldwin. Beginning with a consideration of the osmotic difficulties of sea- and fresh-water fauna and how these are met, the author proceeds to the devices used by land animals for conservation of water, and the biological significance of the different ways in which nitrogen is excreted in different groups of land and sea animals, particularly in relationship to the ornithine cycle and purine metabolism. A section is devoted to the strange distribution of the two phosphagens. Recent work on the biochemistry of the supply of oxygen to the tissues in relation to respiratory pigments is summarized, and is followed by a brief descriptive account of some pyrrol, indol and carotene pigments. This last chapter on pigments seems a trifle abrupt, and less well woven than the earlier chapters into the general evolutionary story.

It is doubtful whether the word uræmia (p. 32 *et seq.*), normally used clinically to describe a definitely pathological condition which may occur irrespective of the level of urea in the blood, is the wisest one to use to describe a physiological condition in which there is a high content of urea in the blood and tissues. It is not quite clear why, if urea were produced in the cleidoic egg, it should disturb osmotic relationships (p. 47), since, apart from the wall of the urinary bladder and the gills of elasmobranchs, most tissues seem to be freely permeable to this substance. It would have been interesting to have had the author's views on the relationship of the recent findings of W. L. Davies, that trimethylamine oxide occurs in appreciable quantities in the urine and milk of dairy cows after they have eaten various beet by-products, with the statement (in the section beginning on p. 43) that it is only in the excreta of marine teleosts that this substance occurs. Does the normal diet of these animals contain large quantities of betaine or related compounds? Is the occurrence of trimethylamine oxide in the excreta more a reflection of the type of compound in the ingesta than of any fundamental metabolic peculiarity?

In case there is virtue in the fact that the reviewer read through this book from cover to cover with the greatest pleasure in a single sitting, let it be put on record. Dr. Baldwin's book may be confidently recommended as a delightfully yet firmly written introduction to this infant science. Sir Frederick Hopkins contributes a characteristic foreword. H. D. K.

# A Modern Climatology

**Handbuch der Klimatologie**

Herausgegeben von W. Köppen und R. Geiger. In 5 Bänden. (1) Band 1, Teil B: Die klimatologischen Elemente und ihre Abhängigkeit von terrestrischen Einflüssen, von Prof. Dr. V. Conrad; Band 1, Teil C: Das geographische Systeme der Klimate, von Prof. Dr. A. Köppen; Band 1: Titel, Vorwort, Inhalt, alphabetisches Sachregister. Pp. x + xii + B556 + C44 + 12. 90 gold marks.

(2) Band 2, Teil J: The Climates of North America. Part 1: Mexico, United States, Alaska. By Prof. Robert DeC. Ward and Prof. Charles F. Brooks. Pp. x + 326. 60 gold marks.

(Berlin: Gebrüder Borntraeger, 1936).

(1) The encyclopædic handbook of climatology by Köppen and Geiger makes a considerable advance by the issue of two new volumes. The first of these, containing vol. 1, Section B and Section C, is a volume of about 600 pages. In Section B Prof. V. Conrad, of Vienna, gives an outline of the climatological elements and their dependence on terrestrial influences. He has taken a wide view of the domain of climatology, and we might perhaps regard much of the matter which he has included as falling rather within the domain of physics of the atmosphere. In view of the thoroughness of the treatment we have no cause to regret the author's choice of topics. In five sections he treats in turn solar and terrestrial radiation, the constitution of the atmosphere and its impurities, the measurement and representation of temperature, wind and air flow, and the hydrometeors. We find throughout the whole book careful discussion of methods of observation and of methods of representation of the observations. Thus the question of how best to obtain a reasonable mean temperature for the day from observations at standard times is considered with some care. The influence of the location and aspect of the observing station on the meteorological conditions is stressed, particularly with regard to temperature and rainfall.

For almost every meteorological element we find tables, charts or diagrams, showing the distribution over the globe, the variation with height, or the diurnal or annual variation. Data from many parts of the world are shown in the text or diagrams. The mean winds of the globe are described, and an outline of the scheme suggested by V. Bjerknes for the general circulation of the atmosphere is added. Special local winds, land and sea breezes, and hill and valley winds are described. The longest section is that dealing with the water vapour in the atmosphere. All aspects of the subject are mentioned. Evaporation is discussed with reference to the theories which have been put forward in such overwhelming numbers. But here the reviewer noted that the work of O. G. Sutton, which he would regard as one of the most valuable of all recent contributions to this most difficult subject, receives no mention. Some idea of the thoroughness with which the author has done his work may be gathered, however, from the fact that he has even succeeded in collecting some data relating to the diurnal variation of rainfall, a subject which few writers have cared to embark upon. References to original papers are plentiful, and form one of the most useful features of the book.

In Section C, Köppen gives in about forty pages an account of the well-known classification bearing his name, which is based on considerations of temperature and rainfall. Köppen distinguishes eleven main types of climate, but there is obviously an almost infinite gradation of possible subdivisions. Fig. 4 shows the annual distribution of temperature and rainfall in each of the main types, and in view of the importance of this diagram it is regrettable that it is on so small a scale. The short account is, however, a useful summary of the bases of Köppen's classification of climates.

The whole volume is one of the most useful additions to the list of reference books of the working meteorologist. It is naturally a severely technical work, and cannot be regarded as light reading by even the most technically minded. But it will have its place in every library of meteorological books.

(2) The second of the two new volumes, vol. 2, Section J, describes the climates of Mexico, the United States and Alaska. Much of the work of collecting and discussing the observations was done under the partial guidance of the late R. de Courcy Ward. He shared with Prof. C. F. Brooks and Mr. A. J. Connor the duties of author, but many American meteorologists contributed to the work of compiling the book. It begins with a general introductory description of the physical features of North America and their bearing on the climates of the continent. We are here reminded that the fact that the continent narrows southward instead of northward has the consequence that, instead of a Sahara, North America has the Gulf of Mexico.

The volume is in three sections, dealing respectively with Mexico, the United States and Alaska. Each of the three sections ends with a series of tables, giving for a large selection of stations monthly and annual means of temperature, pressure, wind directions, relative humidity, days with snow, hail, thunderstorms, strong wind, or fog, to name but a selection of the contents. The text discusses these observations, charts and diagrams being freely used where desirable. Most of the charts cover the whole of the continent, including Canada, though the climatology of Canada is to form the subject of the next volume, which is due to appear shortly. The authors have carried out their difficult task with care and good judgment. Of particular interest are the chapters in the section on Mexico dealing with climate and vegetation, and climate and population, and in the section on the United States dealing with climate and health and climate and crops. The volume will be valuable to all who are interested in the meteorology, climatology, or economics of the North American continent.

The general editors of this monumental climatology, Köppen and Geiger, are to be congratulated on the way in which the work not only progresses, but also maintains the high standard which marked its early stages. One cannot help a feeling of envy of the American colleagues, who will have an excellent and up-to-date climatology of their country at their elbows, while wondering why no one has yet seen fit to produce an equally complete modern climatology of the British Isles.

D. B.

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# Analytical Chemistry

**Textbook of Quantitative Inorganic Analysis** By Prof. I. M. Kolthoff and Dr. E. B. Sandell. Pp. xv+749. (New York: The Macmillan Co., 1936.) 20*s*. net.

IN this work, the production of well-known teachers and investigators of analytical subjects, we have one of the best productions on the subject of quantitative inorganic analysis available to students. It sets out from the position that analytical chemistry is a fundamental branch of the science, a statement which the reviewer accepts fully.

The presentation of the subject is such that many who have passed beyond the stage of the advanced student and have reached the heights of research will find it profitable to read the volume. The theory of *p*H values, solubility product and the electroanalytical process is given sufficiently fully for practical purposes. A chapter on errors in analysis will repay careful study, and we may recommend in particular that part of the chapter dealing with significant figures obtained in the course of an analysis. The section on volumetric analysis is introduced by a very useful discussion of the theory of the various branches of this class of analytical operations. It includes a fairly full account of potentiometric titrations, and of various types of indicators, many of which, for example, erioglaucine *A* and phenanthroline, are here given the attention they deserve.

A short section of the book is devoted to physico-chemical methods, and that part which deals with colorimetry and spectrophotometry should prove valuable to all who have to use colorimeters in their work. The use of so-called unspecific properties (density, refractive index, etc.) for the analysis of mixtures is dealt with rather too briefly, as is indeed the rest of the chapter, which gives an outline of some other physico-chemical properties useful in investigation. While the methods here described for the analysis of brass and steel are useful and practical, it is a matter of opinion whether the space devoted to these matters might not possibly have been better utilized for fuller discussion of some of the physico-chemical methods. We agree that the description of the analysis of silicate rocks is valuable to the student because of its wide and general application, but the description of the examination of these two alloys seems to the reviewer somewhat restricted for a work which is so philosophic in its general outlook.

The subject matter is well arranged and has adequate references to original papers and special works on analysis, while the descriptions of the more important gravimetric and volumetric processes are sufficient. For teaching purposes, three different sizes of type have been employed, and this, together with the problems set at the end of the chapters, will be found particularly advantageous in using the book.

This work can be recommended with confidence as providing the foundations of a sound training in theoretical and practical quantitative analytical chemistry. We have not discovered any errors, and misprints, if any, must be very few indeed. We agree heartily with the views on the scope and purpose of the study of analytical chemistry propounded in the preface. J. J. F.

**Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage**
By Prof. Frank R. Theroux, Edward F. Eldridge and Prof. W. LeRoy Mallman. Second edition, revised and enlarged. Pp. x+228. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 15*s*.

THIS book is essentially a utilitarian product, greatly appreciated as proved by two editions appearing within nineteen months: the added bacteriological section further enhances its value.

The first part is chemical, subdivided into three sections, water, sewage and polluted water; these arbitrary divisions cause some duplication. The instructions are efficient, concise, well arranged and furnished with calculated examples from selected data. This part describes the preparation of the necessary solutions and reagents and concludes with chemical notes on analytical methods. Here the preparation of the caustic soda solution seems wasteful, while the diluting water for the B.O.D. (biological oxygen demand) misses the point by aeration after adding alkali.

Part 2 gives an efficient account of the bacteriological examination of water and sewage; also the composition of the required media; these follow on the lines of the American Public Health Association methods—hence *B. Welchii* is omitted. The number of media enumerated is excellent. However, the absence of Noble's official cyanide citrate medium for the Coli-ærogenes group is noted. The colon index method is used for routine comparative purposes; the Phelps and M.P.N. (most probable number) methods are given.

Calculations with numerous illustrative examples are prominent throughout. Unfortunately, small errors occur; p. 118, the atomic weight of iodine is a unit larger than usual; the equation is unbalanced; p. 119, the alkali equivalent is 0·1 per cent too high.

The organic determinations are, by a strange irony, the least satisfactory part of our present methods, due to unrealized errors and artefacts. The shepherding care here devoted to the nitric nitrogen in the Kjeldahl process deserves emulation even in more pretentious works; it would confer inestimable benefits upon all concerned and is fundamentally necessary to progress. J. W. HAIGH JOHNSON.

**Die Tsetsefliegen:**
ihre Erkennungsmerkmale, Lebensweise und Bekämpfung; ein Leitfaden für die Praxis. Von Dr. F. Zumpt. Pp. iv+149+15 plates. (Jena: Gustav Fischer, 1936.) 9 gold marks.

DR. F. ZUMPT, of the Institute of Tropical Diseases at Hamburg, has provided in the above work a concise and up-to-date manual on the tsetse flies. Within the compass of about 140 pages he has described the essential features of their structure, taxonomy, habits and the means for attempting their control.

The first section is devoted to general features of their morphology: this is followed by a short account of their methods of feeding and of reproduction. A longer section is given to taxonomy, wherein the characters employed for determining the various species are dealt with, together with accounts of their habits and geographical distribution. A short general statement of tsetse ecology follows, together with a more detailed discussion of ecological methods of study. The concluding part is concerned with the problem of combating these insects, both by purely local methods, such as trapping, and by the more comprehensive schemes of destroying or altering their natural environment. At the end of the work is a very complete bibliography (up to 1936) comprising about 400 references to separate publications.

While this manual gives a good presentation of the subject as a whole, its most useful part will probably be found in the account of the taxonomy and specific characters of these insects. A. D. I.

**Forest Insects:**
a Textbook for the Use of Students in Forest Schools, Colleges and Universities, and for Forest Workers. By Prof. R. W. Doane, Prof. E. C. Van Dyke, Prof. W. J. Chamberlin and H. E. Burke. (American Forestry Series.) Pp. xii+463. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 25*s*.

THE realization of the national importance of forestry, which has overtaken the North American continent in recent years, has manifested itself in various ways. Forest protection and reafforestation, in particular, have come to the front. Under the term protection come not only the combating of forest fires but also of the many biological enemies of living trees. Among these latter, insects are the most important.

Practical people in forests and parks, as well as teachers and students in academic institutions, need properly documented information to which they can refer. The present book aims at filling requirements of this kind. In its first four chapters general principles are dealt with in a brief and elementary fashion. Nearly seven eighths of the book are given to accounts of forest insects themselves. The essential information about each species is provided, while the bibliographies at the ends of the chapters guide the reader to sources giving fuller details.

The book is well arranged and clearly illustrated, and should admirably fulfil its purpose as a manual for North American use.

**Méthode des caractéristiques pour l'intégration des équations aux dérivées partielles linéaires hyperboliques**
Par Mlle. Hélène Freda. (Mémorial des Sciences mathématiques, Fasc. 84.) Pp. vii+82. (Paris: Gauthier-Villars, 1937.) 15 francs.

WITH great skill and clarity, Mlle. Freda has presented an account of the origin, development and applications of one of the most powerful methods of mathematical analysis. Starting with Cauchy's problem and Riemann's original method, she traces the extensions due to Picard, Volterra, d'Adhémar, Tedone, Coulon and Hadamard, with modifications and additions due to herself. There are references to mechanical and physical applications, and to the history of the subject. Prof. V. Volterra contributes an appreciative preface. H. T. H. P.

# Water-Power in the United States

By Dr. Brysson Cunningham

II

## Grand Coulee Dam

THE second of the great power projects in the United States to be described is the Columbia Basin Project, Washington. It includes the construction of a dam which, when completed, will be the second highest in the world; the formation of an artificial reservoir with an area of 82,000 acres or 128 square miles; the installation of a power plant which will ultimately exceed the capacity of any other now in existence, and an important irrigation canal system over adjacent territory.

The Columbia River, rising in the Canadian Rockies and crossing into the State of Washington near its north-east corner, has the greatest run-off but one in the country. It flows for 750 miles through the State into the Pacific Ocean, falling 1,300 ft. in its course, and is the largest river in the United States in point of potential power susceptible of economic development. It is obviously, therefore, a very suitable subject for exploitation in the interests of industry and agriculture.

The impounding dam is at the mouth of the Grand Coulee (Fig. 1), a natural basin formed by an earlier diversion of the river channel, probably during the glacial epoch, about 22 miles north of Almira and 92 miles by road west of Spokane. The work of dam construction was commenced in December 1933, and is expected to be completed by the end of the current year. As originally designed, the height of the dam was fixed at 300 ft., with a crest length of 3,400 ft., which would have served for a power development of 520,000 horse-power. It was the intention thereafter to superimpose a high dam upon this low dam, when funds became available for a combined irrigation and power development scheme. Constructional difficulties, however, arose from slides in the canyon walls above the site, and a consideration of the objectionable bonding of two structures, with the uneconomical accommodation for hydraulic machinery to cope with low-head and high-head conditions, led to the substitution, at the outset, of a dam of the concrete straight-gravity type, rising about 550 ft. above the lowest point of the foundation bed and capable of raising the river-water surface-level by 355 ft. This dam,

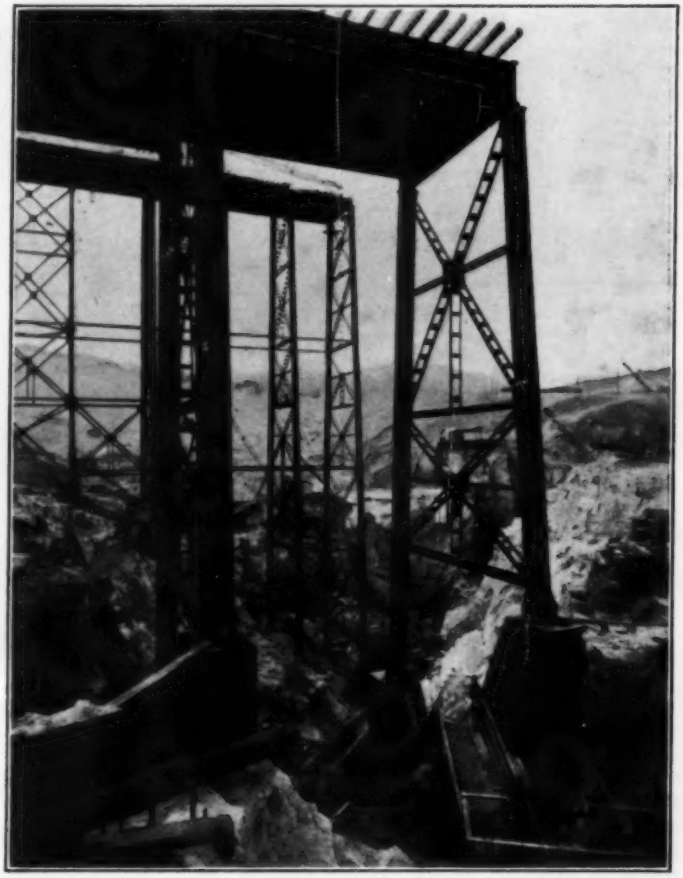

Fig. 1.

VIEW OF EXCAVATION IN PROGRESS (DECEMBER 1936) AT GRAND COULEE INSTALLATION. THE CONCRETING OF THE DAM JUST COMMENCED.

superimposed on the natural granite, will have a crest length of about 4,200 ft., with a 1,650 ft. overflow spillway in the river channel portion, affording a flow capacity of a million cusecs. The structure is of enormous size, containing, with the power-house and other appurtenant works, no less than 11,250,000 cubic yards of concrete masonry, weighing more than twenty million tons—roughly, three times the volume and weight of the Boulder Dam.

The reservoir formed by the dam will extend for a distance of 151 miles from the Grand Coulee to the Canadian border, and up the Spokane River for 32 miles. The width averages a little more than 4,000 ft. The Columbia River, it may be added, is five times as large as the Colorado River, on which the Boulder Dam is located. The volume of water to be impounded in the Columbia River reservoir is sufficient to supply nearly 2,000 gallons for every inhabitant on the earth. In contrast with the Colorado River, the Columbia River water is practically free from silt.

The installed capacity of the Grand Coulee power plant will be 2,700,000 horse-power—half as much again as that of the Boulder Dam plant and six times as much as that of Niagara Falls. The continuous power output will be 1,240,000 horse-power. There are to be two power houses, one on each side of the dam, containing eighteen 150,000 horse-power vertical hydraulic turbine and eighteen main generating units of 120,000 kVA. capacity each, 60 cycles. There will also be three 7,500 kVA. service units. Water will reach the turbines through eighteen penstock culverts, 18 ft. in diameter, and the machines will operate under an average head of 335 ft. (maximum 360 ft.; minimum 265 ft.). It is expected that the plant will be ready to commence partial operation in 1942.

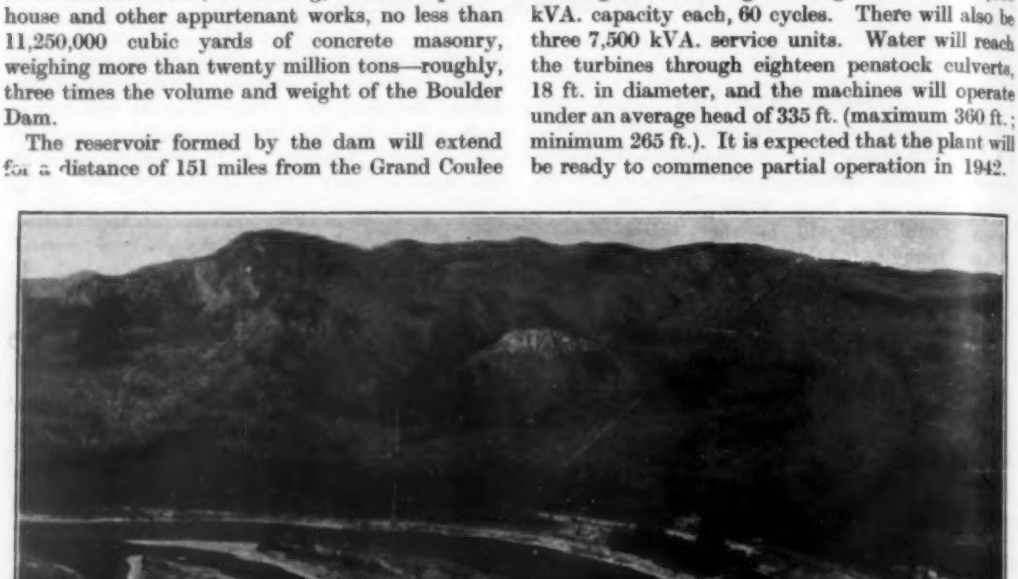

Fig. 2.

GENERAL VIEW OF THE BONNEVILLE INSTALLATION; UPSTREAM SIDE OF POWER HOUSE AND LOCK, WITH SITE OF MAIN DAM.

The reservoir is to be provided with an installation of twelve pumps, of 1,600 cusecs capacity each, driven by a 65,000 horse-power motor against a normal head of 295 ft., discharging through 13 ft. diameter outlets, about 700 ft. long, in a canal which leads to the reservoir.

The flow of the Columbia River is on an average 109,000 cusecs. The greatest recorded maximum is 492,000 cusecs, but it is believed that a peak of 725,000 cusecs was reached at Grand Coulee during the flood of 1894. The minimum discharge, after completion of the dam and the introduction of regulation, will be about 35,000 cusecs.

Irrigation is possible over an area of about 1,200,000 acres in the Columbia Basin, of which 980,000 acres will be by gravity and the remainder by supplemental pumping. The district lies on the east side of the Columbia River, between Soap Lake on the north and Pasco at the extreme southern end, with a maximum width of 60 miles. The land has been declared to be "the best undeveloped irrigation area on the continent".

The estimated ultimate cost of the entire undertaking is 377,000,000 dollars (£75,400,000) of which 179 million dollars is assignable to the dam and power plant and the balance to the irrigation system. The initial development at the Grand Coulee Dam is estimated to cost 60 million dollars.

## II

### Bonneville Dam

The Columbia River furnishes other sites than the foregoing for the economical exploitation of water-power, including Rock Island and Bonneville. The former of these has already been developed by private enterprise; the development of the latter, Bonneville, is now in hand by the U. S. War Department Corps of Engineers under an authorization of Congress on August 30, 1935. The main features of the Bonneville undertaking are a dam, a power house, a ship lock and fishways. The total cost, inclusive of an initial installation of two (out of ten) power units of 60,000 horse-power each, will amount to 45 million dollars (£9,000,000).

The Bonneville site (Fig. 2) is about 143 miles from the coast of the Pacific and the river is tidal for that distance. At this point, the river flows in a westerly direction in two channels, separated by Bradford Island. The dam is being constructed in the north or main, channel, while the power house and navigation lock are located on the south channel. The bedrock under the principal structures is a sedimentary deposit of volcanic ash, largely intermixed with pebbles and rock fragments of all sizes, and is locally known as Eagle Creek formation. There is a mushroom-shaped intrusion of andesitic lava of high quality which forms the foundation for the lock and the power house.

The dam is a concrete gravity structure at the base, supporting reinforced concrete piers for eighteen vertical lift steel gates. The gate openings are each 50 ft. wide and the piers 10 ft. thick, making the length of the dam proper, 1,090 ft. The width at the base is 200 ft. and the height above lowest foundation, about 170 ft. A service roadway is to be carried across the piers, so that the completed dam will have the appearance of a concrete multiple-arch bridge. The dam is designed to pass a flood of 1,600,000 cusecs—37 per cent in excess of the volume of the flood of 1894.

The ultimate capacity of the power installation will be ten 43,200 kw. units, 3 phase, 60 cycles, and one 4,000 kw. station service unit. Each of the main turbines will be of 60,000 horse-power, with a head of 45 ft. and a flow of about 2,200 cusecs.

The ship lock is designed to receive ocean-going vessels, so that by deepening the channel below Bonneville (the natural depth of which at low water ranges from 7 ft. to 50 ft.) such vessels may ascend from Vancouver to The Dalles, about 50 miles above Bonneville. The lock will have clear dimensions of 76 ft. in width by 500 ft. in length, and a depth of 24 ft. over the lower sills at low water.

The information on which the foregoing article is based has been supplied by the Bureau of Reclamation, Department of the Interior, Washington, so far as the Grand Coulee installation is concerned, and by the Corps of Engineers, U. S. Army, Washington, in relation to the Bonneville project, to both of which bodies, acknowledgments are also made for the photographic illustrations.

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# Medical Research in 1936

IN addition to the usual summary of the present position of many aspects of medical research, the report of the Medical Research Council* discloses that steps have been taken during the past year to develop the Council's policy of establishing senior clinical posts for whole-time work in research and higher teaching, such as will give a satisfactory career in later life to young men who devote themselves to the scientific study of clinical problems. The Council already supports, in whole or in part, three clinical research units in London, at University College Hospital, Guy's Hospital and the National Hospital for Diseases of the Nervous System. Reference is made to the establishment of a department of clinical research at Cambridge, under the regius professor of physic, in which research students are supported by the Elmore Fund, and to Lord Nuffield's gift to the University

* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1935–1936. (Cmd. 5378.) Pp. 172. (London: H.M. Stationery Office, 1937.) 3s. net.

of Oxford for the development of research and post-graduate teaching in medical science.

The Council has given special attention to another aspect of the problem, namely, the training of young clinicians with academic and research appointments in view: for this purpose it has instituted six post-graduate studentships and four research fellowships in clinical science and experimental pathology. The students receive a grant for personal maintenance while undertaking approved courses of study in Great Britain, which may include modern languages as well as advanced physiological, pathological and special clinical work under recognized teachers. The fellowships are for candidates who have already had some experience in the use of research methods, and are intended as probationary appointments for research in clinical science and experimental pathology under suitable direction in Great Britain.

The Council has also always considered problems of health and disease in relation to tropical conditions within its sphere: in fact, one of the chief reasons why it was originally placed under the direction of the Privy Council was that it should be free from territorial limitations. With the prospects becoming more favourable of being able to institute a wider programme of work in the tropics, the Council has appointed a Tropical Medical Research Committee, which contains representatives of the Colonial Office and of the Liverpool and London Schools of Tropical Medicine. The Committee having advised that the most effective means open to the Council of promoting investigations in this subject is the establishment of a small staff of highly qualified workers giving their whole time to research under the best possible conditions, the Council has awarded two junior and two senior fellowships with the view of training suitable candidates in research in tropical medicine. The Council's further intention is to establish, as suitable investigators become available under this scheme, permanent and pensionable appointments for research work in tropical medicine including senior posts: members of this staff will work partly in the tropics and partly in institutions at home. The terms of service will be as favourable as those applying to other Government appointments for men of similar professional standing.

There have been three changes in the constitution of the Council during the year: the Marquess of Linlithgow, Prof. E. D. Adrian and Mr. W. S. Morrison have retired and been succeeded by Lord Balfour of Burleigh, who becomes the new chairman of the Council, Prof. J. Mellanby and Mr. R. K. Law. Reference is made in the report to the award of the Nobel Prize in Medicine for 1936 to Sir Henry Dale, conjointly with Prof. O. Loewi of Graz, in recognition of their work on the nature of the chemical mechanism involved in the transmission of nerve impulses, and to the loss suffered by the National Institute for Medical Research by the death of Captain S. R. Douglas: Sir Patrick Laidlaw has been appointed to succeed Captain Douglas as deputy director of the Institute and head of the Department of Experimental Pathology and Bacteriology.

The scientific researches carried out by members of the scientific staff of the Council and by other workers supported by grants-in-aid cover the whole field of medical research: it is possible to refer to only a few of the more outstanding advances during the past year in this review.

Investigations have been continued on the properties of different viruses: in the case of influenza, it has been shown that the virus obtained in various outbreaks of the disease in widely distant parts of the world is identical with that originally isolated in Great Britain. Conclusive proof has also been obtained of the identity of the experimental disease in ferrets with influenza in man; an infection originally obtained from human sources and since passed repeatedly from ferret to ferret, has been retransmitted by accident to a human being. Progress has been made in the study of methods for the immunization of man against this disease by use of vaccines; but nothing suitable for application in more than an experimental way has yet been achieved.

A new method of determining the size of the particles of different viruses has been used to check results obtained by differential filtration. The rotor of a Sharples centrifuge, closed at the lower end, is lined with a thin layer of a weak agar gel, which is allowed to set during rotation: the suspension to be separated forms a layer only a small fraction of a millimetre in depth on the surface of the agar when the rotor is spinning, so that the particles become entangled in the gel and are protected from re-suspension when the rotor is decelerated. The correspondence between the figures given by filtration and centrifugation has been found in all cases to be a good one.

A characteristic of the known pathogenic viruses has been the failure, hitherto, to grow them in artificial culture media free from organized cellular material which they can infect. A group of free-living non-pathogenic organisms, of about the size of vaccinia virus, has now been discovered living in London sewage; they grow readily on ordinary bacteriological media, in which they can be maintained indefinitely in pure culture. The suggestion that propagation of viruses is possible only under conditions of intra-cellular parasitism, since the system of enzymes and surfaces necessary for self-reproductive life could not exist within a

sphere of such small diameter as that of a virus, is therefore inapplicable to viruses of the size of the vaccinia group—about 150 millimicrons. The existence of these free-living organisms raises the hope that means may yet be found for growing some of the pathogenic viruses in artificial culture.

Analysis of some recent studies of nutrition in Great Britain has shown the relative constancy in the distribution of calories between protein, fat and carbohydrate eaten by people in different towns: in particular, the percentage of protein eaten is constant, at 10–11 per cent in St. Andrews, Cardiff and Reading. In spite of this, the types of foodstuffs eaten are widely different: in fact, the constant percentage intake of protein and the similar calorie intake of people living far apart, are obtained independently of the type of foodstuff eaten and seem to represent the result of some kind of instinct. As regards the daily calorie intake, a recent investigation of the diet of more than a hundred women students showed the daily intake to be 2,035 calories per person. This intake is considerably less than the usual standard of 3,000 calories, which has itself been considered by some workers to be too low. The analysis of these diets led to the conclusion that few can be considered really poor: on the other hand, many of them, particularly with reference to their content of 'protective' foodstuffs such as milk, green vegetables and fruit, leave much to be desired. The remedy is the education of the average housewife in the relative nutritive value of different foodstuffs.

Epidemic diseases still remain one of the greatest enemies of mankind, although some have been partially or even completely conquered. Problems relating to the spread of epidemics have been studied by field investigations of epidemics naturally occurring among human beings; but there are still many problems which have resisted field investigation because the difficulties of collecting statistical evidence prevent the assessment of the importance of inter-related factors. The experimental study of the spread of epidemics in a population of mice, as carried out for many years at the London School of Hygiene and Tropical Medicine, has provided answers to certain of these problems. Thus it appears that in large herds living under conditions favourable to the spread of epidemic disease, and receiving regular additions of healthy animals, the disease will persist indefinitely. The form of the mortality curve and the size of the herd are determined mainly by the rate of immigration. In epidemics initiated by virulent organisms, the rate of mortality during the early days of herd life is high, reaching a low level between the fortieth and sixtieth days of cage life. The expectation of life from the twentieth to the thirtieth day rises continuously but never reaches that of normal healthy mice. It is considered that both selection and natural immunization play a part in the increased average resistance displayed by surviving animals, the latter being the more important.

Another important subject which is discussed in the report is the problem of the prevention and treatment of puerperal (or childbed) fever. Summing up the present position, the report states that modern investigation suggests two lines of prevention, with a reserve line of treatment if the first two lines of defence are broken down. First, childbirth should be so conducted that access of pathogenic organisms to the birth-canal is rigorously excluded, especially streptococci from the throats of medical attendants, friends or the patient herself. Secondly, the diet should be of such a nature as to raise the resistance to infection to the highest possible level; this means an ample consumption of milk, green vegetables and other protective foods. Finally, if infection does occur, there is evidence that the new chemotherapeutic compounds, 4-sulphonamido-2-4 diaminoazobenzol and *p*-aminobenzene sulphonamide, will reduce both the mortality and the incidence of complications.

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# Obituary Notices

## Prof. W. M. Wheeler

IN the death of Prof. William Morton Wheeler, the United States loses an outstanding personality in the biological world and a man whose reputation spread far beyond the confines of his native country. The first intimation of his death received in England was a telegram from Dr. T. Barbour of Harvard University to Prof. J. Stanley Gardiner, on April 21. He died suddenly in Harvard Square, Cambridge, Mass., on the evening of April 19, after having only very recently returned from a journey in Mexico.

Born at Milwaukee (Wisconsin) on March 19, 1865, Wheeler graduated from the German-American Normal College in that city in 1884. In June 1885, he became a teacher of German and philosophy in the High School, Milwaukee, under George W. Peckham, a well-known student of spiders and social insects. In 1887 Wheeler became custodian of the public museum in his native city, and gave up this post in 1890 on being made a fellow of Clark University, under G. O. Whitman. He graduated Ph.D. there in 1892 and, in the same year, became instructor

in embryology at the University of Chicago: in 1897 he was assistant professor. While at Chicago, Wheeler went on study leave to Europe (1893–94), working under Boveri at Würzburg, and at Liège; he also occupied the Smithsonian table at the Naples Zoological Station. In 1899 he became professor of zoology at the University of Texas; in 1903 he was made curator of invertebrate zoology in the American Museum of Natural History, New York, and from 1908 until 1935 he was professor of entomology at Harvard University. In addition to the last-named post, he was dean of the Bussey Institution of that University from 1915 until 1929.

Much of Wheeler's early researches were in the domain of general zoology—especially morphology and embryology. Mention may be made of his work on the development of the urino-genital system of the lamprey (*Zool. Jahrb.*, **13**, *Anat.*; 1899): his contribution on the peculiar Annelid *Myzostoma* (*Naples Mitt.*, **12**; 1896) and his large treatises on insect embryology (*J. Morph.*, **3**; 1889: **8**; 1893) besides several articles written in German and contributed to the *Zoologischer Anzeiger*. Wheeler's work on insect embryology, it may be added, is still important to-day. This kind of occupation, however, failed to stisfy him: "My association with Peckham, Whitman and Patten," he wrote, "had converted me into a hard-boiled morphologist." Henceforth he devoted himself to the insect world and developed his predominant interest in ant life. On this subject alone he must have published more than a hundred and fifty papers, covering most aspects of their economy. On the systematic side he has left a great output of high-class work, but it was the living creatures which attracted him most and especially the peculiar relations of ants to other insects and to the plant world. In addition to his great text-book on ants (1910), in the Columbia Biological Series, the treatise of more than 1,000 pages on the ants of the Belgian Congo (1921–1922) is a monument to his industry and to the other workers who collaborated with him. Wheeler's lectures given at the Lowell Institute, Boston, in 1922 formed the basis of his book "Social Life among the Insects" (1923). This work was greatly amplified in the elaborately documented "Social Insects, their Origin and Evolution" (Paris, 1926; London and New York, 1928). In 1928 there were also published his books "Emergent Evolution and the Development of Societies" and "Foibles of Insects and Men". In 1931 there appeared the book "Demons of the Dust: A study in Behaviour"—an attractively written study of parallelism in evolution as revealed by two widely divergent insect types. His last book was "Colony Founding among Ants", published in 1933, but I believe that he left material for at least one other book at the time of his death. He was active to the very end, and some of his latest papers only came to hand a few weeks ago.

All who knew Wheeler—and his friends are scattered in many lands—will feel a sense of personal loss, for he inspired genuine affection and regard. Many will recall his keen sense of humour as revealed in his published addresses and other writings, or in telling a good story. During his teaching career, at the Bussey Institution, each year brought its quota of students who came to work under him. Many who have now made distinguished careers owe their start to Wheeler's counsel and guidance. His interest was mainly in the research man rather than the undergraduate. Having discussed a programme of work with a student, the latter was usually left to his own devices, for Wheeler rarely visited his students in the laboratory. All who brought their difficulties to him, however, found him both helpful and sympathetic. Wheeler possessed the faculty of inspiring confidence in his men and succeeded in stimulating their best efforts.

Wheeler was a man of simple tastes and with the mind of a scholar. Besides a knowledge of the classics, he was thoroughly familiar with several European languages. His favourite reading for a number of years past covered many aspects of philosophy, psychology and sociology, written in several tongues. With this background, ripened by extensive travel and first-hand observation in the tropics and other lands, he brought to bear a penetrating insight into his interpretation of the evolution and behaviour of social insects. As expositions of such phenomena his writings are unsurpassed.

Wheeler belonged to most of the chief scientific societies of America. He held the degrees of Sc.D. of Harvard and Chicago Universities and of LL.D. of the University of California. He was an honorary member of the Entomological Societies of France and Belgium and was one of the twelve honorary fellows of the Royal Entomological Society of London. His first visit to Europe was in 1893 and he last visited England in 1935, when he attended the British Association meeting of that year. He married Miss Dora Bay Emerson of Rockford, Illinois, in 1898, who survives him together with a son and a daughter.

A. D. IMMS.

## Prof. L. Mangin

LOUIS MANGIN, former director of the Museum national d'Histoire naturelle in Paris, died at Orly on January 27 last. Born at Paris on September 8, 1852, Mangin was of Lorraine origin. He first studied botany under Le Monnier at Nancy and then with van Tieghem at Paris. He became professor of natural sciences at the Lycée of Nancy when twenty-one years of age, and at Louis-le-Grand when twenty-nine. His first researches showed the influence of his teachers and were concerned with plant anatomy and physiology; his thesis for his doctorate was on the adventitious roots of Monocotyledons. In collaboration with Gaston Bonnier he undertook research on respiration, transpiration and carbon assimilation, with results which are of interest in the historical developments of these subjects. This was followed by investigations on the physiology of Basidiomycetes, pioneer work which has not been much added to in the fifty years which have since elapsed.

Mangin then turned his attention to the structure of cell membranes, and by his methods of microchemical analyses and differential staining laid the

foundation of modern histological research; that on the membranes of Mucorineæ and Peronosporaceæ is still the basis of text-book descriptions.

From the physiology of fungi and the structure of membranes it seemed logical to pass to the study of fungal infections, and this Mangin did with such effect that he is rightly regarded as one of the founders of French phytopathology. His best-known investigations are those on the diseases of wheat, chestnut, vine (with Viala) and fruit trees; he also studied rots of timber.

In 1904, Mangin was appointed professor of the classification and natural families of Cryptogams at the Museum national d'Histoire naturelle in succession to Dehérain, who had held the chair since 1880, but as professor of vegetable physiology. Here his enthusiasm and administrative ability resulted in his being surrounded by a group of active workers—but in conditions which were surprisingly bad. He continued his investigations and became interested in phytoplankton. One aspect of his work which has not received the recognition due to it, was the attempt to add precision to the description of moulds. In 1920, he was elected by his colleagues to succeed Edmund Perrier as director of the Museum. His administrative duties, particularly heavy on account of the effects of the War, left him little opportunity for research, but he devoted what time he could spare to the study of phytoplankton. By the time he retired in 1931 he had extended the activities and raised the prestige of the Museum; but perhaps his greatest service was the building of the magnificent new Botanical Gallery at a cost of twenty million francs, of which the Rockefeller Institution gave five millions.

Louis Mangin showed his character in his work; when one met him he appeared somewhat reserved but alert and practical, though ever ready to extend to younger men courtesy of a kind suggestive of an older generation. J. R.

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We regret to announce the following deaths:

L. B. L. Belinfante, secretary of the Geological Society of London in 1916–30, and editor of the *Quarterly Journal* in 1890–1930, on April 10.

Dr. A. P. Wills, professor of mathematical physics in Columbia University since 1910, on April 17, aged sixty-four years.

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# News and Views

## Royal Society: New Fellows

At the meeting of the Royal Society held on May 6, the following fellows were elected: Dr. J. D. Bernal, lecturer in crystallography, University of Cambridge; Prof. A. C. Chibnall, assistant professor of biochemistry, Imperial College of Science and Technology; Prof. G. R. Clemo, professor of chemistry, Armstrong College, University of Durham; Dr. A. N. Drury, lecturer in pathology, University of Cambridge; Prof. H. Munro Fox, professor of zoology, University of Birmingham; Prof. W. E. Garner, professor of physical chemistry, University of Bristol; Dr. S. Goldstein, lecturer in mathematics, University of Cambridge; Dr. Percival Hartley, director of biological standards, National Institute for Medical Research; Prof. H. L. Hawkins, professor of geology, University of Reading; The Rev. J. E. Holloway, lecturer in botany, University of Otago; Dr. W. Hume-Rothery, Warren research fellow of the Royal Society; Dr. T. G. Mason, Cotton Research Station, Trinidad; J. Reid Moir, archæologist; Dr. M. L. E. Oliphant, assistant director of research, Cavendish Laboratory, Cambridge; Dr. C. F. A. Pantin, lecturer in zoology, University of Cambridge; Dr. D. R. Pye, deputy director of scientific research, Air Ministry; Dr. E. C. Stoner, reader in physics, University of Leeds.

## Coronation Honours

The following names of scientific workers and others associated with scientific work appear in the list of Coronation honours conferred by H.M. the King: *Barons:* The Right Hon. Christopher Addison, first Minister of Health, 1919–21, and Minister of Agriculture and Fisheries, 1930–31; Sir John Cadman, chairman, Anglo-Iranian Oil Company and Iraq Petroleum Company. *G.C.M.G.:* Sir Frederick Leith Ross, chief economic adviser to His Majesty's Government. *K.C.B.:* E. J. Forsdyke, director and principal librarian, British Museum; Prof. E. Mellanby, secretary of the Medical Research Council. *K.C.M.G.:* Sir David Chadwick, secretary of the Imperial Economic Committee and of the Executive Council of the Imperial Agricultural Bureaux; Prof. A. P. W. Thomas, emeritus professor of botany, zoology and geology, Auckland University College, New Zealand. *Baronet:* Sir David Milne-Watson, president of the National Gas Council and Governor of the Gas Light and Coke Company. *Knights:* Prof. R. W. Chapman, professor of engineering, University of Adelaide, South Australia; Brigadier H. J. Couchman, surveyor-general of India; Dr. Allen Mawer, provost of University College, London, and director of the Survey of English Place Names; Colonel A. Olver, expert adviser in animal husbandry to the Imperial Council of Agricultural Research; Dr. R. H. Pickard, director of the British Cotton Industry Research Association; Dr. D'Arcy W. Thompson, professor of natural history, University of St. Andrews. *C.H.:* Prof. C. T. R. Wilson, for services to experimental physics.

*C.B.:* Major-General H. M. Perry, honorary surgeon to the King, director and professor of pathology, Royal Army Medical College; Dr. D. R. Pye, director of scientific research, Air Ministry; B. Rackham, keeper, Department of Ceramics,

Victoria and Albert Museum. *C.M.G.:* A. J. Findlay, director of agriculture, Zanzibar; C. F. M. Swynnerton, director of tsetse research, Tanganyika Territory. *C.I.E.:* J. F. Blakiston, director-general of archæology in India; Colonel J. Taylor, director, Central Research Institute, Kasauli; Lieut.-Colonel C. Newcomb, chemical examiner to the Government of Madras, and principal, Medical College, Madras; F. Ware, officiating expert adviser in animal husbandry to the Imperial Council of Agricultural Research.

*C.B.E.:* Prof. A. L. Bowley, emeritus professor of statistics in the University of London; Prof. E. L. Collis, emeritus professor of preventive medicine in the University of Wales, a member of the Miners' Welfare Committee; G. S. Colman, member of the Pastoral Research Council, Commonwealth of Australia; Dr. A. D. Crow, director of ballistics research, Research Department, Royal Arsenal, Woolwich; Colonel J. Heatly-Spencer, honorary physician to the King, professor of tropical medicine, Royal Army Medical College, and consulting physician to the Army.

*O.B.E.:* W. P. Brewis, chairman of the Newcastle Society of Antiquaries, member of the Council of the Roman Society; H. J. Burrell, for contributions to natural history in the Commonwealth of Australia; R. Daubney, chief veterinary research officer, Kenya; H. N. Linstead, secretary and registrar of the Pharmaceutical Society of Great Britain; A. Main, chief inspector of agriculture, Department of Agriculture for Scotland; A. Morley, lately staff inspector, Board of Education; Prof. A. J. Perkins, formerly director of agriculture in the State of South Australia; F. S. Richards, deputy surveyor-general to the Egyptian Government; H. W. Simmonds, entomologist, Fiji; Dr. J. M. Stagg, senior technical officer, Meteorological Office, Air Ministry; D. Stewart, deputy conservator of forests, United Provinces; J. G. Stewart, chief inspector of agricultural education, Ministry of Agriculture and Fisheries. *M.B.E.:* W. L. Watt, agricultural officer, Kenya; L. F. Wacher, agricultural officer, Basutoland. *I.S.O.:* A. H. Cockayne, director-general, Department of Agriculture, Dominion of New Zealand; A. More, deputy Government chemist.

## Prof. W. L. Bragg, O.B.E., F.R.S.

PROF. W. L. BRAGG, who has been appointed director of the National Physical Laboratory, has held the Langworthy chair of physics in the University of Manchester since 1919. Beginning his research work at Cambridge in 1912, about the time when v. Laue had announced his discovery of the diffraction of X-rays by crystals, Prof. Bragg was attracted to this field of work. One of his early papers explained, in terms of the 'reflection' principle, the nature of the patterns observed in the Laue photographs. Along with his father, Sir William Bragg, he developed the X-ray spectrometer. The determination of the structures of the simpler crystals followed, until in 1915, their work was recognized by the joint award of the Nobel Prize for Physics. After his appointment at Manchester, Prof. Bragg quickly established a school of workers engaged in investigations of the solid state of matter. His own particular interest has been in the orderly arrangement of atoms in crystals and in relations between atomic arrangement and the properties of a crystalline substance. The field is a very wide one, and is of interest, not only to the physicist, but also to the chemist who is seeking to understand the nature of the forces which bind atoms together and to the industrial research worker who wants information about the structure of his working materials.

FOLLOWING the first period, in which the simpler crystal structures were investigated by X-ray methods, the determination of the structures of more complex crystals was made possible, principally through the development of methods of analysis using the intensities as well as the directions of reflection of the X-rays. In this phase of the work, Prof. Bragg and his co-workers have determined a range of complex structures of minerals, particularly silicates and zeolites. During the last few years, Prof. Bragg and his team of research workers have been particularly interested in an experimental and theoretical study of the atomic arrangements in alloys and in the effect of heat treatment on these structures. Prof. Bragg's laboratory in Manchester has been one of the principal centres in Great Britain for the investigation of the structure of crystals, and students from all parts of the world have visited the laboratory, either for training in this field of research or for the privilege of working under Prof. Bragg's supervision.

## Prof. A. O. Rankine, O.B.E., F.R.S.

IT is announced that Prof. A. O. Rankine, professor of physics in the Imperial College of Science and Technology since 1919, will resign that position at the end of the present academic year in order to join the staff of the Anglo-Iranian Oil Company as chief physicist. Prof. Rankine has for some years acted as geophysical adviser to the Company and in his new position he will take charge of all physical investigations carried out by the Company. The appointment is another interesting and significant example of the migration from the academic to the industrial world of a distinguished man of science, and is evidence of the ever-growing importance of science and scientific research in modern industrial development. It may be remembered that Sir John Cadman, the chairman of the Anglo-Iranian Oil Company, was himself at one time a professor in the University of Birmingham. During his chairmanship of the Company, since 1927, notable work in the development of the relatively new science of geophysics has been carried out since 1924 by the Company, which introduced geophysical surveying in the country formerly known as Persia and now to be called Iran. In the development of geophysical science, Prof. Rankine has played a notable part, and will no doubt find in his new sphere increased scope and opportunity for further advances.

### Awards in Anthropology

THE Wellcome Gold Medal for research in anthropology for 1936 has been awarded by the Council of the Royal Anthropological Institute to Dr. Charles Kingsley Meek for an essay entitled "Law and Authority in a Nigerian Tribe". In accordance with the terms of award laid down when the medal was instituted by the late Sir Henry Wellcome, the subject of research is the application of the science of anthropology to the problems of administration among backward peoples. Dr. Meek was formerly an officer of the Nigerian administrative service, and has for long been known as the foremost authority on the native tribes of Northern Nigeria. He is the author of a number of works in which the ethnography of the territory has received detailed treatment. The Council of the Institute has also awarded the Rivers Memorial Medal to Dr. Edward Evan Evans-Pritchard. This medal is awarded in recognition of recent meritorious field work. On this occasion, the Council has had before it the results of Dr. Evans-Pritchard's work in the Anglo-Egyptian Sudan and in Kenya since 1926. Dr. Evans-Pritchard, who was educated at Exeter College, Oxford, and studied anthropology at the London School of Economics, was appointed in 1926 by the Sudan Government to carry on the ethnographical survey of the tribes of the Anglo-Egyptian Sudan which had been initiated by Prof. C. G. Seligman, and later for a time was professor of anthropology in the University of Cairo. He has also acted as honorary secretary of the Royal Anthropological Institute. From time to time, the earlier results of his researches have been published in *Sudan Notes and Queries* and in the *Journal of the Anthropological Institute*. His further studies have appeared recently in a work on witchcraft among the Azande, which has been pronounced by those most competent to judge to be one of the outstanding works of recent years in anthropology. Dr. Evans-Pritchard is now engaged in preparing a further work on the religion and social organization of the Azande.

### Wool Research in Australia

THE decision of the Australian Government last year, at the instance of pastoralists, to impose a levy on wool production, has been followed by the appointment of a Wool Board, with six members representing the industry and one the Commonwealth Government. The levy may be up to 6*d*. per bale, and the funds are to be used for (i) scientific research and (ii) publicity for the benefit of all sides of the wool industry. The Board has recently determined upon its expenditure under the first heading during the next financial year, and its decisions should result in marked stimulation of scientific work, particularly of that being carried on under the auspices of the Council for Scientific and Industrial Research. £2,750 has been granted for extensions to the Council's Nutrition Laboratory in Adelaide; £1,600 for sheep blowfly investigations at Canberra and Sydney; £900 for provision of additional accommodation at the McMaster Laboratory in Sydney; £730 per annum for three years for parasitological field work; £100 capital and £370 per annum for three years for further study of external parasites of sheep; £500 for the Council's field station at St. Mary's, some twenty miles from Sydney; £484 for three years for increased staff for fertility studies; and minor amounts for further investigations into toxæmic jaundice, foot-rot and ophthalmia in sheep.

IN addition to these grants, the Australian Wool Board has agreed to support a project for establishing in South Queensland a field station for large-scale investigations of sheep problems, including tests of methods for mitigating the blowfly pest. The Queensland Government has granted the Commonwealth Council a thirty years lease, at a peppercorn rental, of an area of 40,000 acres in the Cunnamulla district. Towards the capital expenditure on buildings, fencing, etc., that will be necessary, the Board has allotted £10,000 in the first year and £7,500 in the second. The establishment of this station is cordially approved by wool-growers throughout Australia, and it should serve as an effective additional link between the practical growers and the research workers in the city laboratories.

### Arms for the British Association

THE British Association has received a grant of armorial bearings from the College of Arms, the necessary fees being met by gifts from an anonymous donor and from ex-presidents of the Association.

The shield is described as azure ten stars, two of six, four of five, and four of four points argent, representing the constellation of Libra; over all a balance or. The motto, *Sed omnia disposuisti*, is taken from "Wisdom of Solomon", ii, 20 (But Thou hast ordered all things in measure and number and weight).

### University of Sheffield and Sir Robert Hadfield

IN NATURE of October 10, 1936 (p. 610), reference was made to the appeal for £250,000 being made by the University of Sheffield for urgently needed extensions and for endowments. The first list of

subscriptions was headed by a gift of £10,000 from Sir Robert Hadfield, to whom the University was already indebted for valuable donations and much support. It is now announced that Sir Robert has increased his donation to £20,000, this being the largest individual gift so far received in answer to the appeal. The announcement was made in the course of his address at the annual meeting last month of Messrs. Hadfields, Ltd., and Sir Robert added that he was moved to add to his original donation by the noteworthy address delivered early last March by General Smuts on "The University in Civic Training", when he was installed as Chancellor of the University of Cape Town. General Smuts believes that the university is the hope of civilization, the one place where fact is exalted above sectional loyalties and ideologies. Sir Robert has given substantial proofs that he, likewise, has faith in the university as an institution of vital significance for the future of humanity. It is to be hoped that his great benefactions to the University of Sheffield will stimulate other industrialists to play their part in supporting more liberally, if not universities in general, at least the particular university to which they must look for development and progress in their own field. Sir Robert Hadfield, it may be noted, celebrated the fiftieth anniversary of his election to the Institution of Civil Engineers on March 1, when he received a congratulatory address from the president, and on March 23 was elected an honorary member of the Institution, for his "long and conspicuous service in the advancement of metallurgical science".

### Decorative Lighting for the Coronation

SINCE the last coronation, twenty-six years ago, great improvements have taken place in the art of decorative lighting. In 1911, metal filament and arc lamps were used. Since then the invention of gas-filled lamps and the development of electric-discharge lamps have greatly cheapened the cost and improved the flexibility of the illumination. The illuminations will show many new aspects of London, and practically all the principal provincial cities will have very effective displays. In London alone there will be nearly two hundred floodlighting installations, and in the provinces, statistics obtained from six hundred local authorities show that the mean additional load per town will be approximately 60 kilowatts. This does not take into account the numerous smaller schemes of strip-lighting and illuminated devices with which shops and business premises will be decorated. For the first time, the fountains in Trafalgar Square are being illuminated by means of eight submersible reflectors taking 500-watt gas-filled lamps. In addition to all four sides of 'Big Ben', the terrace of the Houses of Parliament is being floodlighted for the first time. Two novelties are, 30-ft. high electric 'bonfires' with flame effects on the roof of the Shell Mex House, and colour changing equipment for illuminating 30-ft. high jets of water from fire floats stationed outside the new London Fire Brigade headquarters. A very large sodium floodlighting installation used at Dunfermline Abbey and Edinburgh Castle give an outstanding and beautiful display of decorative lighting.

### The German Airship Disaster

THE latest and largest German airship, *Hindenburg*, was destroyed by fire while landing at Lakehurst, New Jersey, U.S.A., on the evening of May 6. This was the terminal point of her first voyage of the year from Frankfort-on-Main. She carried 39 passengers and 61 crew, approximately half of whom were killed or afterwards died of injuries. The airship had been cruising about for an hour during a heavy storm, which was judged to be too severe for safe landing, and was just coming in at about 300 feet above the ground, dropping her nose mooring lines for the landing crew on the flying field. Reports state that a burst of flame was seen at the stern. In a few moments the whole ship was enveloped in fire. This was evidently due to the ignition of the hydrogen in the gas bags, as the report mentions the exceptional brilliance of the fire. No details are yet available upon which any useful theories as to the cause of the fire can be based, but the fact that the ship had been cruising around the field in a heavy thunderstorm lends colour to the suggestion that she was electrically charged, and raises the possibility of sparks having occurred when the landing ropes earthed her. It is known that special precautions against this were embodied in her design, and therefore this theory assumes some additional accident. Whatever was the original cause of the accident, it is certain, as was the case with the British airship *R* 101, that the ignition of the highly inflammable hydrogen was responsible for the completeness of the disaster.

### The Electrical Industry of the World

THE twenty-ninth report of the Imperial Economic Committee (London : H.M. Stationery Office. 2*s*. 6*d*. net) gives a survey of the trade in electrical machinery and apparatus. The latest information given relates to the year 1935. Perhaps the most significant feature during the last five years is the leading part that radio receiving sets have been occupying. At the end of 1935 there were 56 million sets of this type of apparatus in use, the increase having nearly doubled in five years. There were 22·5 million sets installed in the United States, and this works out to 178 per 1,000 of the population. The consumption of electrical energy used in radio receiving was 1,540 million kilowatt hours per annum. The corresponding figures for Great Britain, which was second in the world's list, was 7·4 million sets, and the third was Germany with 7·2 million. On the other hand, the increase in the world's telephones was comparatively small. This is ascribed primarily to an actual decrease in the United States and Canada. But these two countries still lead in this form of communication. It is worthy of note that there is a greater number of telephones per head of population in agricultural countries like Denmark, New Zealand and Australia, than there is in industrial

countries such as Great Britain, Germany and France. Probably this is due to the greater facilities of communication by other methods in the latter countries. Russia has come to the front as an electrical manufacturing country. This is shown by the fact that the value of its imports, which rose gradually from 3·62 million pounds in 1929 to 9·15 million pounds in 1932, has fallen rapidly to only £789,000 in 1935. The outstanding example of self-sufficiency is the United States, the imports of which in 1935 were valued at only £427,000.

### Present State of British Bird Ringing

THE 1936 report on bird ringing in the British Isles (*British Birds*, April 1937) supports what the 1935 report indicated, namely, that future progress lies not in increasing the sum total, but rather in increasing the proportion of adult birds over nestlings, and scarcer species, marked. Although the total of 48,663 birds ringed is below the number for previous years, the total of trapped adult birds, 19,235, is a record, while that for nestlings (where mortality is naturally high) of 29,428 is a decline on the previous years. Dr. H. J. Moon again heads the list of ringers with 5,280 birds ringed, including 1,332 lapwings, 975 song thrushes, 849 blackbirds and 587 starlings; Mr. G. Charteris marked 3,524 birds, 1,166 of which were chaffinches, and Mr. E. Cohen marked 3,024 birds, including 865 shearwaters. There is an increasing number of birds ringed by schools and societies, and the two bird observatories. The Oxford Ornithological Society marked 2,639 birds, Bootham School 1,656, Rugby School 1,050, the Midlothian Ornithological Club 813, the British Empire Naturalists' Association 158, the Zoological Society 511 and Leighton Park School 403. Totals of ringed birds are not quite so significant as the numbers of birds of rarer species marked. Among the ringings of the Oxford Ornithological Society, for example, were 67 kingfishers, Skokholm Bird Observatory marked 27 white wagtails and 20 Greenland wheatears, Mr. A. Maynall marked 409 nightingales, Mr. C. Wontner Smith marked 201 rooks, Rugby School marked 169 rooks and 62 carrion-crows, Leighton Park School marked 21 fork-tailed petrels, Dartington Hall School 12 cirl buntings, the Isle of May Bird Observatory a barred warbler, two bluethroats and a Continental coal tit. Of the national total, the most numerous species ringed were: 3,191 lapwings, 2,155 Manx shearwaters, 1,530 Sandwich terns, 1,271 common terns and 1,131 herring-gulls.

### The National Institute of Agricultural Botany

THE seventeenth report of the National Institute of Agricultural Botany, Cambridge, is now available, and copies may be obtained on application to the Institute (Huntingdon Road, Cambridge). The work of the Institute is directed to supplying the farmer with unbiased information as to the seeds he sows, and the report deals with methods by which this information was obtained in 1936. New varieties of all farm crops are tested by the Institute as soon as they appear, the trials being conducted on a field-scale at six permanent stations in England, and in some cases at additional centres on a farmer's own land. In all cases, the varieties are grown just as they would be by the farmer himself. Every feature of the varieties is noted and the results are often extremely enlightening. For example, of all the new varieties of winter wheat that have been tested in the last ten years, only one has proved to be worthy of general recommendation by the Institute. This is the Dutch variety 'Juliana', which has in the past two years' trials given slightly better results than 'Wilhelmina'. The position with other crops is very similar, and it is clear that farmers will be well advised, before deciding to grow a new variety, to apply to the agricultural organizer for their county, or direct to the Institute, for information as to the merits of the variety in question.

### "The Hero"

LORD RAGLAN writes in reference to the review of his book "The Hero" appearing in NATURE (March 27, p. 532): "Your reviewer . . . suggests that in the absence of documentary evidence I would feel constrained to deny the existence of Nelson and Napoleon. My contention is that in the absence of documentary evidence we should none of us have heard of Nelson and Napoleon." In reply, the reviewer says that, in effect, Lord Raglan appears to agree. In so far as Nelson and Napoleon are characters in the folk drama, they stand on the same footing as Robin Hood, Maid Marian and the rest. These two names, however, were not an effort of invention, but were chosen as those of the popular hero and bogey of the day. Their survival in this form is an effect of folk memory and not of documentary evidence, and their appearance in a ritual does not preclude their real existence, however incongruous their dramatic action. In this instance, the inference happens to be supported by documentary evidence. The conclusion to the contrary, however, that is, that without documentary evidence we should not know of their existence, is shown not necessarily to hold good. Approved documentary evidence is the only source of certain knowledge, and to this extent Lord Raglan is above criticism; but the archæologist maintains, on the other hand, that a legend may embody facts which may in certain conditions afford a clue to interpretation, when his evidence points in a certain direction. The story of the Minotaur may be ritualistic; but the setting of the Minoan civilization is the fact to which it gave Sir Arthur Evans the clue. It may be true that, strictly speaking, in the absence of documentary evidence we have no certain knowledge of Minos; but we have all heard and believe in the existence of the head of the great empire, for whom his name is the generic term.

### Russian Railway Transport

AT the International Exhibition of Art and Technique in Modern Life which is to be opened in Paris this month, Soviet railway transport will be well represented, the principal exhibit being a working

model of the new locomotive *SO* 17–635 which recently completed a successful test journey of 13,000 miles hauling a goods train of 1,200 tons. This engine is an outstanding development of the steam locomotive and, in its way, a pioneer, having been designed for the conditions of Middle Asia and the Far East where, owing to the scarcity of water, the provision of adequate supplies may represent as much as 40 per cent of the total cost of construction. The engine has a special tender equipped with radiators for condensing the exhaust steam, and tanks for collecting the condensate. After being passed first through an oil separator, the exhaust steam enters a turbine which drives the fans for cooling the steam when it reaches the radiators. In this way, with an initial supply of 10 tons of water, it is claimed that the engine can make a run of 627 miles without replenishment. The trial trip was organized for the purpose of testing the behaviour of this locomotive in severe winter conditions, with different kinds of coal, and on the steep gradients which are numerous in the mountainous districts. Travelling from Moscow to Vladivostok and back, it passed over eleven main lines of the U.S.S.R., and the long run, it is stated, was completed without a hitch. Further Soviet exhibits at the Paris Exhibition will include working models of other steam and electric locomotives and of new types of railway coaches specially adapted to Russian and trans-Siberian conditions of travel. The growth of railway transport in those regions is indicated by recent official figures, which show that in 1935 the total length of the railways in the U.S.S.R. was 52,500 miles and that last year they carried 990·8 million passengers and 484·2 million tons of freight.

## Research in Tropical Medicine

THREE junior fellowships are offered immediately by the Medical Research Council for award to qualified medical men wishing to receive training with the view of careers in research work in tropical medicine. The fellowships will be tenable for three years. The stipend will be at the rates of £300, £400 and £500 per annum in the successive years, with an additional allowance during service abroad and necessary expenses. In three years' time, at least one senior fellowship will be available for candidates who have held the junior fellowships mentioned above. This will be awarded for a further period of three years, carrying stipend at the rate of £600–£750 per annum, with an additional allowance during service abroad and expenses. The time will be spent mainly in research work in the tropics. The Council is also prepared to consider immediate applications for senior fellowships from candidates who have had adequate experience in research work, whether already specially trained in tropical medicine or not. The Council further intends to establish in due course permanent and pensionable appointments for research work in tropical medicine, including senior posts. Members of this research staff will work partly in the tropics, and partly in institutions at home to which they will be severally attached. Further information can be obtained from the Secretary, Tropical Medical Research Committee, 38 Old Queen Street, London, S.W.1, with whom applications should be lodged not later than June 15.

## Royal Geographical Society Awards

THE King has approved the award of the Royal Medals of the Royal Geographical Society as follows: The Founder's Medal to Colonel C. G. Lewis, for his surveys on the Miri Mission, 1911–12, in Iraq and Syria, 1918–19, and on the Afghan and Turco-Iraq Boundary Commissions; for the air survey of the Irrawaddy Delta, 1924; and for his promotion and encouragement of the exploration and survey of the Himalaya; The Patron's Medal to Mr. Lincoln Ellsworth, for his work in developing the technique of aerial navigation in the Polar regions, culminating in his successful flight across the Antarctic in 1935–36. The following awards have been made by the Council: The Murchison Grant to Mr. Ronald Kaulback, for his surveys in South-eastern Tibet; the Back Grant to Mr. L. R. Wager, for his work in mountain physiography; the Cuthbert Peek Grant to Mr. V. E. Fuchs, to assist him in his expedition to Lake Rukwa, East Africa; the Gill Memorial to Mr. George B. Barbour, for his work on the geology and geography of China.

## Institution of Electrical Engineers Premium Awards

THE Institution of Electrical Engineers has made the following award of premiums for papers read during the Session 1936–37, or accepted for publication: Institution Premium to Dr. E. A. Speight and O. W. Gill; Ayrton Premium to Dr. D. Robertson; Fahie Premium to Col. A. S. Angwin and Mr. R. A. Mack; Kelvin Premium to Dr. T. E. Allibone, D. B. McKenzie and F. R. Perry; Paris Exhibition (1881) Premium to J. A. Sumner; Overseas Premium to Dr. A. L. Green, Dr. G. Builder and Dr. O. O. Pulley; Extra Premiums to Dr. P. Dunsheath, L. H. Harris, E. H. Jolley and F. O. Morrell; H. Trencham and K. J. R. Wilkinson; Mr. W. R. Debenham; Dr. W. Jackson, Mr. H. A. Thomas; Wireless Section Premiums to Dr. Benjamin, C. W. Cosgrove, and G. W. Warren (Duddell Premium); Commander F. G. Loring, W. L. McPherson and W. H. McAllister, T. L. Eckersley; Meter and Instrument Section Premiums to W. F. Randall; Dr. E. Hughes; Dr. C. Dannatt; Prof. J. T. MacGregor-Morris and Mr. V. A. Hughes; Transmission Section Premiums to H. G. Taylor (Sebastian de Ferranti Premium); J. Eccles.

## Radio Communication Conference at Bucharest

THE Fourth Reunion of the Comité Consultatif International des Radiocommunications (C.C.I.R.) will take place in Bucharest on May 21–June 8. The previous meeting was held in Lisbon in 1934 (see NATURE Sept. 29, p. 490), and in the intervening three years the various national committees have investigated miscellaneous technical problems in connexion with radio communication. The matters under discussion at the present time include the study of the propaga-

tion of waves, direction finding, the measurement and means of suppression of the various types of interfering noise experienced in radio reception, and the improvement of transmitters, particularly from the point of view of frequency stability and the consequent reduction of inter-station interference. Other matters which will be discussed at Bucharest, and upon which it is evidently desirable to secure the greatest measure of international agreement, concern the allocation of wave-bands to the various types of radio-communication services, and the nomenclature employed in designating these wave-bands and the corresponding frequency ranges. It is anticipated that some twenty nations will participate in the Bucharest conference, and the British delegation will include representatives of the Post Office, National Physical Laboratory, British Broadcasting Corporation and the various manufacturing and operating companies.

### Magnetic Disturbances and Auroras

WRITING with reference to the notes on this subject in NATURE of May 8, p. 790, Father J. P. Rowland states: "I greatly regret that by inadvertence I misread in my notes a horizontal force range in minutes of arc, before converting into gammas, as a declination range, and so gave the extreme declination range as 93′, whereas it should be 62′ as given in my letter to *The Times*. The extreme range in horizontal force, exceeding 620$\gamma$ is correct. There was another notable magnetic disturbance from May $4^d$ $17^h$ to $5^d$ $18^h$ U.T. with ranges in declination and horizontal force of 28′ and 234$\gamma$ respectively, probably associated with an elongated group of sunspots which crossed the central meridian on April 29."

### Comets

MR. L. E. CUNNINGHAM at Harvard has detected the periodic comet Grigg-Skjellerup. Its position on April $30^d$ $1^h$ $30^s$ U.T. was R.A. $6^h$ $59^m$ $0^s$, N. Decl. 7° 53′ 27″, mag. 13. In the "B.A.A. Handbook" for 1937 the elements and also an ephemeris are given, perturbations being taken into account. Comparison with this ephemeris indicates that perihelion will be reached on May 23.0 U.T., which is about half a day later than the predicted time. Dr. M. Davidson has used observations from February 4 to April 1, forming normal positions, and finds that Comet 1937*b* (Whipple) is moving in an elliptic orbit with eccentricity 0·999619. The period is very long—about 300,000 years.

### Announcements

AT the request of the Council of the Royal Society of Edinburgh and in terms of the Bruce-Preller Lecture Fund, Prof. H. S. Taylor, of the Department of Physical Chemistry, Princeton University, will deliver an address on "Heavy Hydrogen in Scientific Research", at the ordinary meeting of the Society to be held on June 7.

DR. W. T. K. BRAUNHOLTZ has been appointed secretary of the Institution of Gas Engineers in succession to Mr. J. R. W. Alexander, who has been appointed general manager of the Associated Gas and Water Undertakings, Ltd., and of the East Surrey Gas Co.

Johnstone and Florence Stoney studentships of the value of £250 each for research in Australia have been awarded by the British Federation of University Women to Miss Mary Elizabeth King and to Miss Joyce Laing, who are both proposing to work on aspects of pathology. A similar studentship will be offered for the year 1938–39.

THE annual congress of the Royal Institute of Public Health in conjunction with the Institute of Hygiene will be held at Margate on May 25–29 under the presidency of Lord Horder. Further information can be obtained from the Secretary, A. Seymour Harding, 28 Portland Place, London, W.1.

THE French Academy of Medicine has awarded the Albert I of Monaco prize of 100,000 francs to Drs. Paul Bouin and Ancel for their work on the sex hormones and the interstitial glands in man.

PROF. LEVADITI, of the Paris Pasteur Institute and member of the Academy of Medicine, has been nominated scientific director of the French League against the Venereal Peril.

THE National Geographic Society announces by its News Bulletin that arrangements are being made to broadcast on June 8 a description of the total solar eclipse of June 9 next from either Canton or Enderby Island in the Central Pacific. The transmission will probably be from an anchored vessel, and will begin from time to time several weeks previous to the eclipse with a description of the preparations.

MESSRS. BERNARD QUARITCH, LTD., 11 Grafton Street, London, W.1, have issued a Catalogue (No. 531, 1937) of books on early medicine and surgery. The gem of the collection is a fine copy of the very rare first edition of William Harvey's "Exercitatio Anatomica De Motu Cordis", printed in Frankfort in 1628. Among other rare and interesting works listed may be mentioned Robert Wyer's "Antidotharius", containing recipes for plasters, salves, ointments, etc., J. Duchesne's "The Practise Of Chymicall and Hermeticall Physicke", William Turner's "Herbal", and a copy of the second edition of Jenner's "An Inquiry into the Causes and Effects of the Variolæ Vaccinæ".

ERRATUM.—In the course of the summary of the Huxley Memorial Lecture delivered by Sir Thomas Holland printed in NATURE of May 8, p. 809, reference is made to the work of "W. T. Blandford". The name should, of course, have been "W. T. Blanford"; and we regret having overlooked the mistake made in the typed summary supplied to us and followed by our printers.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 845.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Rate of 'Organification' of Phosphorus in Animal Tissues

RADIOACTIVE isotopes as indicators in biological problems were first used by Hevesy[1]. Recent progress in the production of artificial radioactive substances makes this field of research one of the most promising, and $^{32}P$, the radioactive isotope of phosphorus with a decay period of 14 days, has already been used as an indicator in animal and plant metabolism[2].

Prof. E. O. Lawrence, of the University of California, kindly gave one of us some pieces of metal from the Berkeley cyclotron. During a chemical analysis of them, we separated a fairly large amount of $^{32}P$ which we used in an investigation of some problems of the intermediary metabolism in rats. The following is a preliminary report on the distribution and the rate of 'organification' of injected sodium phosphate.

TABLE 1. LIPIDIC PHOSPHORUS.

| Tissue | Per gram of moist tissue | | Specific activity | | |
|---|---|---|---|---|---|
| | Weight of P (mgm.) | Activity (R.U.) | | | |
| Liver | 1·083 | 19·2 ± 0·6 | (18·6) | 17·8 | (15·7) |
| Intestine | 0·905 | 12·9 ± 0·5 | (16·0) | 14·4 | (12·6) |
| Kidney | 1·237 | 16·3 ± 1·9 | (17·7) | 13·2 | (8·2) |
| Parenchyma | 1·073 | 9·2 ± 0·7 | (10·3) | 8·5 | (7·1) |
| Muscle | 0·480 | 1·4 ± 0·1 | (3·4) | 2·9 | (2·3) |
| Brain and medulla | 1·822 | 0·9 ± 0·4 | (1·7) | 0·5 | (−0·2) |

TABLE 2. ACID-INSOLUBLE PHOSPHORUS.

| Tissue | Per gram of moist tissue | | Specific activity | | |
|---|---|---|---|---|---|
| | Weight of P (mgm.) | Activity (R.U.) | | | |
| Liver | 2·015 | 34·1 ± 0·7 | (17·8) | 16·9 | (16·0) |
| Intestine | 1·353 | 15·5 ± 0·5 | (12·7) | 11·5 | (10·4) |
| Kidney | 0·902 | 7·8 ± 1·0 | (12·2) | 8·7 | (5·2) |
| Parenchyma | 1·610 | 14·2 ± 0·7 | (10·0) | 8·8 | (7·5) |
| Muscle | 0·520 | 3·8 ± 0·2 | (8·4) | 7·3 | (6·2) |
| Brain and medulla | 0·802 | 1·2 ± 0·6 | (3·1) | 1·3 | (−0·4) |

A young rat was fed on a diet containing only fats and proteins and practically free from phosphorus and calcium, and was injected daily for four days with sodium phosphate containing $^{32}P$; afterwards it was bled.

The tissues were successively extracted with hot alcohol and alcohol plus ether. The extracts purified with chloroform were mineralized with nitric and sulphuric acids, and the phosphorus determined according to Neumann-Gregersen. We call this fraction *lipidic phosphorus*. The residue of the alcohol-ether extraction is treated with cold trichloroacetic acid; in a fraction of the extract we precipitate directly ammonium phosphomolybdate (*mineral phosphorus*) and the second fraction is again mineralized in order to determine the *acid-soluble phosphorus*. In the mineralized residue of the two successive extractions we determine the *acid-insoluble phosphorus*.

The radioactivity of phosphorus belonging to each fraction was measured with an ionization chamber in arbitrary units (R.U.). Absorption of the β-rays by the precipitates, and also natural decay were taken into account. For the sake of brevity we omit the data referring to mineral phosphorus and to acid-soluble phosphorus. The main conclusions from these fractions are:

(*a*) That the specific activity of phosphorus, that is, the ratio between activity and weight of phosphorus, is about the same in all tissues examined, except in brain and medulla where it is distinctly lower.

(*b*) That there may be, judging from a comparison of the activities in the fractions of the acid-soluble phosphorus and the mineral phosphorus, some low organic compounds which are synthesized in muscle intestine and liver, from inorganic phosphorus.

Tables 1 and 2 show the weight of phosphorus, per gram of moist tissue, its radioactivity and its specific activity, for lipidic phosphorus and acid-insoluble phosphorus respectively. We give also the probable error of the radioactive measurements and the extreme limits of specific activity supposing the true error to be three times the probable error.

*Lipidic phosphorus* (Table 1). Both activity and specific activity show a maximum for the phospholipids in the liver, intestine and kidney; they have medium values in the other parenchymous organs (spleen, pancreas, adrenals, testes, lungs, heart) and lower values in muscle and brain and medulla.

These results confirm the assumption of a fairly active metabolism of phospholipids in liver and intestinal mucosa which has been put forward by one of us[3] and Sinclair[4], and suggest an extension of the assumption also to the kidney. Moreover, they show that the participation of the phospholipids to intermediate metabolism is not limited to a substitution of fatty acid radicals in the molecule of phospholipids, but results, at least partially, in a complete synthesis starting from inorganic phosphorus, even if this is simply injected.

The differences which we have found depend evidently upon large differences in the rate of synthesis of phospholipids in different organs and therefore afford some hints on the problem of the function of phospholipids in cell economy.

*Acid-insoluble phosphorus* (Table 2). Though this

fraction contains different phosphorated compounds, it is probable that the greater part consists of nucleoproteins, which are the most complicated products entering into the structure of living beings.

Due to the different content of nucleoprotein phosphorus of different tissues, one notes different activities per gram of fresh tissue; specific activity is relatively high in the liver and perhaps in the intestine, while it is roughly the same in muscle, parenchyma and kidney. Brain and medulla show a very low specific activity; that is, the rate of synthesis of nucleoproteins is minimal in nervous tissue, as we have seen for the phospholipids synthesis.

We thank the Radiation Laboratory of the University of California for the gift which made this investigation possible.

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## Reflection of Atmospherics at an Ionized Layer

WE have been studying the wave-form of the electromagnetic pulse radiated from a lightning flash known as an 'atmospheric'. Incidental to the observations which we have made, evidence has been obtained of the reflection of atmospherics at an ionized layer.

The atmospherics are received on a vertical aerial, which is connected through an aperiodic amplifier to a cathode ray tube. The spot on the screen of this tube is photographed on a film fixed to the external surface of a cylindrical drum, which rotates at a uniform peripheral speed of 900 cm./sec.

Some hundreds of wave-forms have been observed, and more than twenty of these show pulses, which appear to have been reflected from an ionized layer at a height above the earth of 78–82 km. Three photographs of wave-forms showing this feature are reproduced in Fig. 1 (*a*), (*b*), (*g*). The intervals of time elapsing between the arrival of the first pulse along the ground and the reflected pulses can be measured for from five to eight reflections at the ionosphere. Assuming the law of optical reflection at the ionosphere and at the ground, and that the ground and sky waves are propagated with the velocity of light, $c$ cm./sec., these intervals of time, $t$ sec., enable both the distance of the flash, $d$ km., and the height, $h$ km., of the reflecting ionized layer to be calculated from the relation

$$ct = 2\,n(h^2 + d^2/4\,n^2)^{1/2} - d,$$

where $n$ is the number of reflections at the ionized layer. In the accompanying table (p.838) the values of $h$ and $d$, which satisfy a least square fit for the observed times, $t$, are tabulated. The fit is sensitive to a change of 1 km. in the value of the height and 10 km. in the distance, and the accuracy of the fit is indicated under $\Delta t$, which is the mean difference in microseconds between the calculated and observed times. The height obtained, assuming the law of optical reflection, is not, of course, the actual height of the reflecting layer, but is the 'equivalent' height.

Independent evidence of the distance from the receiving aerial of the lightning is entered in the last column. Only for the first case is the distance in this column more than a rough estimate, and in that case observers at Flinders Island, distant 380 km., and at the Eddystone light, distant 450 km., reported lightning at the time of the observation. An observation with the cathode ray direction-finder taken

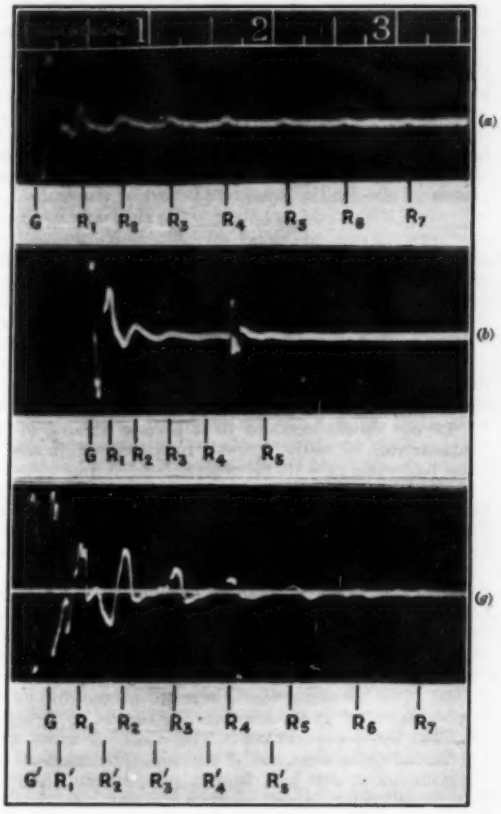


Fig. 1.

ATMOSPHERIC OSCILLOGRAMS FROM LIGHTNING DISTANT 175–500 KM. $G$ IS THE GROUND WAVE AND $R_1$, $R_2$, . . . $R_7$ ARE THE REFLECTED WAVES. IN ($g$), TWO SETS OF REFLECTIONS $G$ . . . $R_7$ AND $G'$ . . . $R'_5$ APPEAR. ON THE TIME SCALE, 1 = 0·001 SEC.

simultaneously with the photograph of Fig. 1 (*a*) confirmed this direction. In the second case the distance is estimated from the deflection of a cathode ray direction-finder. In the last four cases visual observations of the lightning were made, and assuming that it came from clouds 6 km. above the ground, the distances given can be calculated.

The evidence for reflection rests on the close fit of the calculated with the observed times of the pulses, and upon the first case where there is independent evidence that the value of $d$ so calculated is correct. Finally, the observations show that an

atmospheric pulse has a fundamental frequency of the order of $10^4$ cycles/sec. For a wave of this frequency, reflection will occur when the ionization reaches a value of the order of 1 electron per cm.$^3$, and this ionization no doubt exists at a lower height than the 90 km., which is given as an average value for the 'equivalent' height of the $E$ layer.

| Obs. | Time | Reflections | Height | Distance | $\overline{\Delta t}$ | Estimated $d$ |
|---|---|---|---|---|---|---|
| a | 17 00 | 8 | 78 km. | 410 km. | 10 $\mu$ sec. | 420 km. |
| b | 15 45 | 5 | 79 ,, | 510 ,, | 40 ,, | 300–500 ,, |
| c | 17 15 | 6 | 82 ,, | 1310 ,, | 50 ,, | Unknown |
| d | 01 15 | 7 | 80 ,, | 175 ,, | 20 ,, | 150 km. |
| e | 01 30 | 7 | 80·5 ,, | 300 ,, | 20 ,, | >250 ,, |
| f | 01 45 | 6 | 79 ,, | 300 ,, | 10 ,, | >250 ,, |
| g | 01 52 | 7 | 79 ,, | 250 ,, | 30 ,, | 200 ,, |

The observations $d$, $e$, $f$ and $g$ were taken on the early morning of February 20, 1937.

These observations, taken at the University of Melbourne between November 1, 1936, and February 1937, have been made as part of the programme of work of the Radio Research Board of Australia.

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## Resonance in the Interaction of Radio Waves.

IN my recent account of a revised theory of the interaction of radio waves[1], mention was made of the following new deductions:

(*a*) In regard to the amount of modulation which a wave $W$ can impress on another wave $W'$, a notable degree of resonance may occur when the frequency of $W$ passes through the value of the local gyro-frequency.

(*b*) A gyro-wave (that is, one having a frequency within a few per cent of this gyro-frequency) can produce observable interaction with suitable medium and long waves when it is radiated by its source at the rate of one or two kilowatts.

(*c*) The following conditions are favourable to the occurrence of gyro-interaction (that is, interaction caused by a gyro-wave): The received wave $W$ is reflected from a region of the ionosphere which lies within about 200 km. from a gyro-station, and has a wave-length which ranges approximately from 2,000 to 500 metres as the distance between the radiator and receiver of $W'$ ranges from 400 km. to 1,200 km.

It was accordingly predicted that, among other broadcasting stations, Lille (247·3 metres) might be found to produce observable interaction with other waves.

This prediction has been confirmed and the deductions stated above have been amply supported by observations made by myself and many collaborators in different parts of Great Britain, Ireland, France and Belgium, during the period March 1–14.

Through the courtesy of Sir Noel Ashbridge of the B.B.C., Prof. René Mesny of Paris, Mr. T. J. Monaghan of Dublin, and other authorities, substantially the following scheme of experimental radiations took place: On separate nights, during 30 minutes between 0005 and 0045 G.M.T., the three gyro-stations Dublin (222·6 m.), London National (261 m.), and Lille, radiated respectively the morse letters $Q$, $B$ and $K$ on tones of 125 and 1,000 cycles/sec. and with a modulation depth of about 75 per cent. On one of these nights, for comparison of the effects produced, London Regional (342 m.) radiated the morse letter $M$ on tones, modulation depths and powers similar to those of London National and in the intervals between the latter's $B$'s. Corresponding respectively to the above three gyro-stations, the following three groups of complementary stations radiated at full power waves which, with the unintended exception of Hilversum I, were modulated only at five-minute intervals and then with characteristic morse letters having modulation depths of 2, 5 and 2 per cent respectively:

Athlone (531 m.);
Hilversum I (1875), Radio Paris (1648), Brussels I (484);
Hilversum I, Luxembourg (1293), Beromunster (540), Strasbourg (349).

It is not possible in this brief note to give more than a summary account of the results obtained, but a more detailed account will be published elsewhere.

The experiments with Dublin and Athlone failed to reveal any gyro-interaction, as might be expected with Dublin's power of 0·5 kW. and under normal conditions in the $E$-layer.

Lille impressed strong modulations on the waves from Hilversum I, Luxembourg and Beromunster when its radiated power was 60 kW., and occasionally weaker modulations when its power was 10 kW. On one of the latter occasions the interaction with the wave from Beromunster which was received at Leicester was strong enough to justify the conclusion that a power of 5 kW. would have caused observable interaction. Infrequently the wave from Strasbourg was also found to be modulated by Lille, and then weakly. Nearly all the ionospheric regions of reflection of the waves having the strongest impressed modulations are within 200 km. from Lille.

London National, radiating at 30 kW., impressed strong modulations on Hilversum I, Radio Paris and (less frequently) Brussels I. The depth of modulation at a low frequency was often about 3 per cent and at times considerably exceeded that of the received characteristic signal, which had been given a depth of 5 per cent. Several observers also heard an impressed modulation when the power of London National was only 5 kW. On one such occasion, Mr. E. W. B. Gill and I estimated that an impressed modulation with about half the intensity of that observed by us would still have been perceptible; from this it may be concluded that a radiated power of about 2 kW. would have sufficed to cause observable interaction. Nearly all the ionospheric regions from which the most strongly affected waves were reflected lie within 200 km. of London.

The simultaneous radiations from London National and London Regional took place on the night of March 11–12. It was then found that, with equal radiated powers, the $B$'s impressed by London National were usually stronger than the $M$'s impressed by London Regional; that often the $B$'s were easily audible when all the $M$'s were absent; and that occasionally the $B$'s were weaker than the $M$'s. Having regard to probable deviations from complete symmetry in the radiation from each of the two stations, it may be concluded that with a given

power London National causes stronger interaction than London Regional. Since their waves are respectively 11 and 45 per cent longer than the local gyro wave-length 235 metres, this result strongly supports the conclusion that resonance exists.

In the experiments with Lille, London National and London Regional, it was usually found that the intensity of the impressed modulation decreased as the modulation frequency increased. This is in accordance with the theory. But on several occasions the intensity with a modulation frequency of 1,000 cycles/sec. was observed to be much stronger than that with a lower frequency: an interesting anomaly in the theory in its present state.

A more complete account of the theory will be given in the issue of the *Philosophical Magazine* of May.

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NATURE, **139**, 68 (Jan. 9, 1937).

## Cosmic Rays and the Magnetic Moment of the Sun

IT is generally assumed that the constant intensity of cosmic radiation at sea-level beyond a certain latitude is accounted for by the 'clocking effect' of the atmosphere, which absorbs all particles of energy below the limit of that latitude resulting from the action of the earth's magnetic field. An important consequence of this assumption is that the latitude at which the intensity becomes constant should be displaced towards the geomagnetic poles as the altitude above sea-level increases, since then the thickness of the absorbing air layer decreases and therefore also the energy absorbed. Compton's mountain experiments[1] already throw doubt on the existence of this displacement, and this doubt is strengthened by Cosyns's stratospheric measurements[2] which, while admittedly inconclusive, indicate that the intensity remains constant north of 49° even at the highest altitudes reached.

There are clearly two possible interpretations of this remarkable result. Either the spectrum of primary cosmic radiation has a sharp threshold at the energy corresponding to the geomagnetic threshold at that latitude where the intensity becomes constant, or else, as suggested by Janossy[3], particles of this energy (and less) are prevented from reaching the earth by the action of the sun's permanent magnetic field, although the moon might also be suspected.

The theory of the allowed cone of cosmic radiation[4] gives for the geomagnetic threshold at 50° about 200 millistörmers (mS.) for particles coming horizontally and 300 mS. for particles coming from all directions. The number $r_e$ measuring the energy of a particle in störmers is connected with the ratio of momentum to charge ($mv/e$) by Störmer's well-known relation

$$r_e = \sqrt{\frac{mv}{eM_e}}\, R_e, \qquad (1)$$

where $M_e$ is the earth's magnetic moment and $R_e$ the earth's radius. Introducing a parameter $r_s$ similar to $r_e$, but referred now to the sun's magnetic dipole moment $M_s$ and to the distance from the sun to the earth, $D$, by the relation

$$r_s = \sqrt{\frac{mv}{eM_s}}\, D, \qquad (2)$$

the same theory shows that, if the ecliptic lies along the solar magnetic equator, $r_s$ must be less than 0·414. Eliminating $mv/e$ from (1) and (2), we obtain:

$$M_s = M_e \left(\frac{D}{R_e}\right)^2 \left(\frac{r_e}{r_s}\right)^2; \qquad (3)$$

which, upon inserting the known magnetic moment of the earth and the known ratio $D/R_e$, gives $M_s = 10^{34}$ E.M.U. If the angle between the sun's magnetic moment and its axis of rotation is small, this value is only slightly changed. It corresponds to a field intensity at the sun's equator of 30 gauss, in good agreement with the results obtained by Hale and his collaborators[5] from a study of the Zeeman effect of solar lines.

It may be readily shown that, while the sun's magnetic field may thus prevent cosmic particles of energy around 200 mS. ($2 \times 10^9$ eV. if electrons, $1{\cdot}6 \times 10^9$ eV. if protons) from ever reaching the earth, if they come from distances large compared with the diameter of its orbit, it does not hinder low-energy particles of suitable angular momentum shot off the sun from reaching the earth, provided either that such particles leave the sun at very high latitude or that its magnetic moment is inclined at a high angle (around 45°) with respect to the ecliptic. This introduces a difficulty in connexion with Birkeland's and Störmer's theory of the aurora polaris, particularly if the particles responsible for the aurora originate in the sunspot belt.

If the interpretation suggested here is correct, there are several consequences which may be accessible to experiment, of which we shall name only two. First there should be a seasonal variation of the intensity of cosmic radiation of lowest energy, of the order of magnitude of the eccentricity of the earth's orbit, with maximum in summer and minimum in winter, arising from the fact that as the earth rotates around the sun the distance between them varies periodically. Secondly, there should be a diurnal variation as a function of solar time with phase which is now being calculated. It arises because the sun's field at the earth is still capable of deflecting particles of energy up to 435 mS. approximately, and therefore there is at the earth both a solar allowed cone and a terrestrial allowed cone, the common region of which varies periodically as the earth rotates around its axis. The magnitude of this fluctuation may be roughly estimated at between 0·1 and 0·2 per cent.

It may be added that the possibility of ascribing the blocking of cosmic particles to a magnetic action of the moon seems excluded on the ground that it would have to possess a magnetic moment about ten thousand times that of the earth; this would give rise to large variations of intensity depending on the position of the moon which have not been found.

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## Molecules in Interstellar Space?

IN a recent note in NATURE[1], and more in detail elsewhere[2], Dr. T. Dunham, jun., has described his discovery of more interstellar lines due to K (λ 7699·03), Ca (λ 4227), Ti+ (λ 3242·6 and others) and a number of other lines the origin of which has not yet been traced (λ 3957·7, λ 4300·3, λ 4232·6). We have to add to these Merrill's interstellar lines[3] (λ 5780, λ 6284).

Dunham's work and his discussion of the occurrence of Ti+-lines forms a landmark in the story of interstellar investigations, as it throws clear light on the mechanism of excitation, and removes a good deal of misconception arising out of the former idea that only Ca+-lines, and the sodium *D*-lines occur in interstellar space.

Dunham's discovery that only such Ti+-lines which arise from absorption in the lowest orbit of Ti+ ($3d^2$. $4s$. $^4F_{9/2}$) occur as interstellar lines and that no Ti+ atom in the next excited state Ti+ ($3d^2$. $4s$. $^4F_{3/2}$, excitation potential 0·012 volt) occur in interstellar space, shows that the reaction between matter and radiation in interstellar space is of a kind which cannot be described in terms of any interspace temperature. The temperature in interspace is very nearly absolute zero, and ionization is produced only by the photochemical action of quanta meeting atoms or ions after long intervals of time in space. The recombination between ions and electrons also take place at very long intervals. The result is that only such states of atoms and ions occur in interstellar space as have infinitely long life.

The argument raises the question: Why should not molecules also occur in interstellar space? In fact, the above arguments, if forced to their logical conclusion, lead us to the view that we should have molecules in interstellar space. Merrill in fact notes that the lines λ 5780·4, and λ 6284·0 discovered by him are diffuse, and in course of a conversation told me that they might be molecular in origin. In fact, the line λ 6283·0 appears decidedly to be due to *molecular sodium*, $Na_2$, due to the transition ($Na_2$: $^1S\,^2S\,A\,^1\Sigma \rightarrow {}^1S.{}^2P\,B\,^1\Sigma$, $n'' = 0$, $n' = 8$). This band is obtained in absorption in molecular sodium, and according to the Franck-Condon principle, the transition is strong as $r''$ (internuclear distance at the lowest state) is $3{\cdot}07 \times 10^{-8}$ cm., and $r'$ (internuclear distance at the excited state) is $3{\cdot}66 \times 10^{-8}$ cm., so the transition $n'' = 0$ to $n' = 8$ is the most probable. According to the arguments presented here, no other line (or band) of $Na_2$ is likely to occur among the interstellar lines.

Merrill's other line (λ 5780) may be provisionally identified with a line of NaK ($n'' = 0$, $n' = 5$), though in this case the identification is less sure.

The molecule which is likely to be most abundant in interstellar space is $H_2$, but as it gives absorption lines only in the Lyman region, there is no possibility of our being able to prove its existence, but lines due to hydrides may be found amongst interstellar lines.

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## A Possible Function of the Osphradium in the Gastropoda

DESPITE the universal occurrence of the osphradium in the mantle cavity of marine Gastropoda and the large size to which it may attain, the current views as to its function are unsatisfactory. It has been considered (*a*) an organ for testing the water which enters the mantle cavity (Bernard[1]), and (*b*) as a chemo-receptor concerned with the detection of food in water (Henschel[2], Brock[3]).

But the sea is a very constant medium, apart from regions near the shore or the mouths of rivers, and the osphradium is present in Gastropoda which live in the open sea under conditions where the water is never contaminated or diluted. There is certainly no correlation between the presence, or size, of the osphradium and the possible need for 'water testing'. The second theory can at best have only a limited application, namely to predacious carnivores or carrion feeders such as *Nassa* and *Buccinum* (studied by Henschel[2] and Brock[3] respectively). It cannot apply to browsing herbivores, for example, *Pterocera* (Yonge[4]) or *Littorina*, deposit feeders such as *Aporrhais* which seek for food with the proboscis (Yonge[5]), or plankton feeders such as *Vermetus* (Yonge[4]) or *Crepidula* (Orton[6]). Yet in all these, with the exception of *Crepidula* where it is reduced, the osphradium is well developed. Moreover, there is nothing in the evidence produced by Henschel or by Brock inconsistent with the possibility that the siphon is the chemo-receptor in carnivorous species. This possibility is being investigated by us.

An alternative theory as to the function of the osphradium has been developed by us as the outcome of work on the ciliary currents in the mantle cavity of *Aporrhais* (Yonge[5]), followed by comparative work on a variety of common marine Prosobranchs and Opisthobranchs. It is suggested that the osphradium is concerned with the *estimation of the amount of sediment* carried into the mantle cavity by the water currents created by the lateral cilia on the gills. Our reasons may be summarized as follows:

(1) Material carried into the mantle cavity is divided into three portions. The heaviest material is removed by way of the inhalent aperture by cilia lining the mantle in this region. The finest material is carried between and over the gill filaments and entangled in the mucus from the hypobranchial gland before being expelled via the exhalent aperture. Medium-sized particles are accumulated invariably *along the line of the osphradium*, before being carried across the floor of the mantle cavity to the exhalent aperture.

(2) The osphradium, besides possessing sense cells (well described by Bernard[1] and by Stork[7]), also possesses very many mucous glands. The secretion of these masses gathers together the material which accumulates on the osphradium. Previous workers have made no suggestion as to the function of these glands.

(3) There is a general correlation between the development of the osphradium and the degree of sediment to which the animal is exposed. For example, it is broad in mud- and sand-dwelling Prosobranchs, such as *Buccinum*, *Nassa*, *Pterocera*, etc.; linear in passive burrowers such as *Aporrhais* and plankton feeders such as *Vermetus*; reduced in *Crepidula*, which is a plankton feeder normally raised

above the bottom. In *Patella*, where secondary gills have appeared, the osphradia are vestigial because material is not normally carried into the reduced mantle cavity, while in the Opisthobranchs, *Scaphander* and *Aplysia*, it is reduced probably in correlation with rejection of sediment by cilia on the edge of grooves on the parapodia which conduct the water currents into the mantle cavity.

It is therefore suggested that the sense cells in the osphradium form a tactile organ which responds to contact stimuli, the impulse being conveyed by way of the osphradial nerve to the visceral ganglia. Blocking of the mantle cavity with sediment is a supreme danger to Gastropoda, and the importance of such a receptor is clear. The invariable association between ctenidium and osphradium is explained on this view, because the former creates the current, in which the quantity of sediment is estimated by the latter. The universal presence of the osphradium, irrespective of the habitat and of the food, is also explained. It is hoped later to follow up this biological study with an experimental analysis of the receptive capacities of the osphradium.

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## Lunar Periodicity in *Homo sapiens* L.

THE belief in a connexion between sexual periodicity and the moon is very ancient[1]. In particular, it is commonly thought that there is some connexion between the moon and menstruation. De Lee[2] stated, without giving any evidence, that the majority of women menstruate during the new moon, thus associating the periodicity with the *synodical* lunar month of 29·55 days. Arrhenius[3] concluded from data of nearly 12,000 menstruations that there is a slight *tropical* lunar rhythm of 27·32 days, and that the average duration of the menstrual cycle is just under 27 days.

We have reinvestigated these questions with data of more than 10,000 menstruations. We find a great variation in the duration of the cycle, both in one individual and between different individuals. The average duration in our cases during 1928–30 was 29 days, but there was a clear inverse correlation between age and the duration of the cycle. Thus the cycle became shorter by a day with every five or six years increase in age, the oldest group (born before 1891) giving an average of 26·9 days, and the youngest (born after 1905) of 30·2 days. If, therefore, the average cycle of one age-group is equal in length to any lunar cycle, then this equality will not be present in any other age-group. Similarly, if the average for a whole population corresponds with a lunar cycle, the correspondence is unlikely to be present in another population having a different age-distribution. Since Arrhenius's average for the menstrual cycle was derived from data which mostly gave the time interval in whole weeks, while in ours the individual averages err by not more than $\pm$ 0·1 day, his conclusion can no longer be accepted.

An exhaustive examination of the number of our cases starting to menstruate on each day of each kind of lunar month has been made, involving statistical and graphical tests. *No correlation* of any kind was found. Arrhenius's data were known by him to be inaccurate, and they showed a systematic error, inherent in their mode of collection, which itself could give the appearance of a lunar periodicity. Our data are far more accurate and do not contain this source of error. We therefore conclude that there is no causal relation between the moon and menstruation, and that the well-known *approximate* coincidence in the duration of the cycles is fortuitous.

A full account of this investigation, embodying a number of other conclusions, will appear in October in the *Journal of Obstetrics and Gynaecology of the British Empire*.

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## Action of Radium Rays on the Growth of Cells *in Vitro*

NUMEROUS experiments on gamma irradiation of cells cultivated *in vitro* have demonstrated their high radio-resistance to doses designed to produce a lethal effect. Sub-lethal doses have the effect of producing changes in the mitotic activity of the culture, while the lethal dose has so far only been observed as a delayed effect.

In continuation of our earlier experiments[1] we tried to work out a suitable dosage and method of application which would enable us to produce in the irradiated culture *itself* graded effects of radium from very slight inhibition of growth to death of the whole colony.

This was achieved in the following way. The source of rays consisted of a plate 1 sq. cm. in area, containing 5·9 mgm. of radium element with a filter of 0·05 mm. monel metal. With this filtration and with the use of a mica plate of 0·15 mm. thickness for the culture, 12 per cent of the soft and 58 per cent of the hard $\beta$-rays were available, in addition to the $\alpha$-rays. By means of a simple centralizer, it was possible to conduct all the experiments under identical irradiation intensities. The radiations were applied to pure cultures of chick's mesenchyme cells cultivated in the hanging drop according to Carrel's method.

In contrast with most investigations hitherto published, irradiations were carried out in a refrigerator at $+6°$ C. By this method of irradiation in the cold, we succeeded in investigating the various effects of radium treatment on the irradiated culture itself.

In all cases where more marked effects are to be produced by prolonged exposure, it is absolutely essential to suspend active cell life during the whole period of irradiation. With the usual method of treatment in the warm, the cells continue to migrate and divide during irradiation and the culture proceeds to develop; however, if the activity of a culture is suspended by cold, it accumulates the

total effect of the rays, without manifest change. When a culture irradiated in the cold is transferred to the incubator, it develops to a degree exactly corresponding to the dose of rays applied. We are thus enabled to establish a numerical relation between the amount of growth inhibition and the dose of rays applied.

The cultures are irradiated immediately after explantation and are then transferred to the incubator. A parallel non-irradiated control culture is set up under identical conditions.

In our experiments, the cell cultures react to dosages ranging from 0·3 mgh. to 206·5 mgh. (3 minutes to 35 hours exposure) as observed in a period of 3 × 24 hours. The effects can be divided into three groups:

(1) Growth inhibition without complete stoppage of growth within the period of observation. The doses employed ranged from 0·3 mgh. to 70·8 mgh.

(2) Marked inhibition of growth with subsequent cell degeneration and stoppage of growth of the culture within the period of observation. Doses: 70·8–177 mgh.

(3) Immediate death of the irradiated culture. Doses 188·8–206·5 mgh.

With doses of less than 47 mgh. the retardation of growth in the irradiated cultures is observed after a latent period of 24 hours. With doses greater than 47 mgh. this latent period is no longer apparent.

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[1] *Z. Krebsforschg.*, **29**, 411 (1929); *C. R. Acad. Sci.*, **192**, 304 (1931).

## Radioactivity induced by Fast Neutrons according to the (*n*, 2*n*) Reaction

IN a letter to NATURE[1], we reported some time ago that we had obtained evidence for the expulsion of two neutrons from the nucleus when copper and zinc were bombarded with the fast neutrons from a (Li + $^2$H) source. In the case of copper, our assumption was confirmed by the experiments of Bothe and Gentner[2], who obtained the same radioactive copper nucleus by irradiating this element with gamma rays, this giving rise to the expulsion of a neutron. According to the latter process the same investigators produced some new radioactive bodies. We attempted to get the same active isotopes with the fast neutrons from our (Li + H$^2$) source according to the process (*n*, 2*n*), the results being as follows.

*Molybdenum.* A strong activity is observed with a period of 21 minutes. Bothe and Gentner found a period of 17 minutes, whilst a 25-minute period is observed with slow neutrons[3]. With slow neutrons (Be + $^2$H + paraffin; intensity equivalent to 3 grams Ra + Be) we also find a 25-minute period, which indicates that these activities are not identical.

*Silver.* A sheet of silver with a filter of 0·4 mm. silver and 0·2 mm. cadmium in front of it was irradiated. In accordance with Bothe and Gentner, we found a period of 24 minutes. The 2·4-minute period is also present.

*Bromine.* The activity induced in bromine shows two periods, one of 18 minutes and one of about 5 minutes. The former has been observed also by Bothe and Gentner. For the short period they give 3·5 minutes however.

*Antimony.* A strong activity with a period of 17 ± 1 minutes is observed, whilst Bothe and Gentner give 13 minutes.

*Tantalum.* A sheet of pure metallic tantalum was irradiated several times for half an hour. Only a very poor activity was obtained. We could not establish the period. Bothe and Gentner found a 14-minute period.

*Tellurium.* A strong activity with a 60-minute period is observed. The same period was found by Bothe and Gentner.

It may be mentioned that our apparatus works at a tension of 250 kV., whilst almost pure deuterium is used. Hence the creation of gamma rays is excluded.

Continuing our experiments, we observed some more examples of this type of reaction and found some new radioactive isotopes:

*Selenium* becomes strongly active when bombarded with fast neutrons. The period is 56 minutes. With slow neutrons (source as mentioned above) we find a period of 22 minutes, whilst Fermi and his co-workers[4] give 35 minutes.

*Cadmium* bombarded with fast neutrons yields two periods, one of 200 minutes and one of about 20 minutes. These activities may be due to $^{109}$Cd and $^{115}$Cd. A very low activity with a period of 70–200 minutes has already been observed when cadmium is bombarded with slow neutrons.

*Mercury* gives a period of 43 ± 1 minutes when bombarded with fast neutrons. With slow neutrons this period was not observed. A chemical separation was attempted by R. W. P. de Vries. It was ascertained that the active nucleus is an isotope of mercury.

*Thallium.* With fast neutrons we obtained a period of 4·1 minutes. As a period of 4 minutes has been observed already with slow neutrons[5], we may ascribe this activity to $^{204}$Tl.

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[1] Heyn, F. A., NATURE, **138**, 723 (1936).
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## Absorption Spectra, Optical Activity and Isotopic Exchange

WE have made a systematic examination[1] of the absorption spectra of cobaltammines which undergo isotopic exchange of hydrogen atoms in constituent $NH_2$ or $NH_3$ radicals, and more especially of those which are mixtures of optical isomers. Cobaltammines almost invariably give rise to two broad absorption bands[2] in the visible (I) and near ultra-violet (II) spectrum. Substitution of $^2$H for $^1$H produces an effect upon band (I) illustrated in Fig. 1; it is generally more pronounced the larger the number of exchangeable hydrogen atoms in the molecular ion. Absorption band (II) is scarcely affected, but differences occur in the farther ultra-violet. The full line is representative of protium-containing cobaltammines, the broken line of corresponding deuterium compounds.

The form of the curves of rotatory dispersion obtained by Mathieu[3] for protium-containing cobalt-ammines dissolved in water suggests that the regions

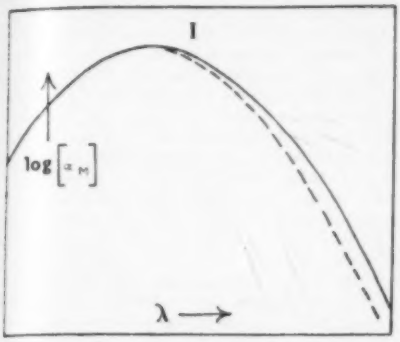


Fig. 1.

of absorption responsible for optical activity are precisely those which we have found sensitive to protium-deuterium exchange; notably the long wave-length side of band (I). Accordingly we have compared the rotatory powers of the protium and deuterium isomers of cobalt tri-ethylenediamine ion, the number of complex ions in the path of the beam being identical in each case; that is, $[Co(H_2N.CH_2.CH_2.NH_2)_3]^{3+}$, hereinafter called [H], dissolved in $H_2O$, and $[Co(D_2N.CH_2.CH_2.ND_2)_3]^{3+}$ hereinafter called [D], dissolved in $D_2O$. The observed rotations are tabulated; the solutions, approximately 0·035 molal, of lævo- [H] and lævo- [D] were rather more concentrated than those of dextro- [H] and dextro- [D].

| Wave Length (A.) | Lævo | | Dextro | |
|---|---|---|---|---|
| | $H_2O$ | $D_2O$ | $H_2O$ | $D_2O$ |
| 5893 | −3·29° | −3·09° | 2·86° | 2·68° |
| 5770 | −4·18° | −3·90° | 3·56° | 3·31° |
| 5461 | −9·57° | −8·86° | 8·03° | 7·43° |

As would be anticipated from the displacement of the absorption edge of band (I), the rotation of [D] is smaller than of [H] at all three wave-lengths; the percentage difference in rotation increases as the absorption maximum at 4665 A. is approached. A complete investigation of rotatory dispersion is contemplated. That the phenomenon is due to the exchange of $^2H$ for $^1H$ and not to other conceivable causes is proved by the following observations. Similar differences of rotation are *initially* observed when [H] and [D] salts are dissolved in pure formamide, but the rotation of the [D] solution gradually increases and after several hours becomes equal to that of the [H] solution which remains unaltered, indicating progressive substitution of $^1H$ for $^2H$ in the molecular-ion. The total number of exchangeable hydrogen atoms in the solvent is enormously greater than in the solute.

The slow exchange of hydrogen isotopes between cobalt hexammine ion and water was recently reported by Anderson, Briscoe, James and Spoor[4], who followed the process by measuring changes in density of the water. We infer from spectroscopic and polarimetric observations, that the corresponding reaction of cobalt tri-ethylenediamine ion is complete well within two minutes at 0° C. But the rate is easily measurable when [D] is dissolved in formamide containing a few parts per cent of $H_2O$, the rotation increasing with time to a final constant value. Conversely, the rotation of [H] in formamide containing a little $D_2O$ falls at first and afterwards rises again. Therefore the fastest rate of isotopic exchange in the system, formamide—[*H*]—$D_2O$, is between [H] and $D_2O$. Whether the subsequent increase in rotation is produced by interchange between the deuteriumated complex ion and formamide or whether the $D_2O$—formamide exchange is partly, though indirectly, responsible cannot yet be decided. Clearly the latter process, if it takes place, is slow.

It seems likely that an indicator of isotopic exchanges more sensitive than $[Co(en)_3]^{3+}$ will be found amongst optically active co-ordination compounds.

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March 29.

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## Combined Ascorbic Acid in Plant Tissues

EVIDENCE was presented some time ago which indicated that a part of the ascorbic acid present in certain plant food materials was present in the combined state[1]. Mack[2], however, still considers that any apparent increase in the ascorbic acid value of cabbage on cooking is to be attributed to the thermal destruction of the ascorbic acid oxidase, and Levy[3], while recognizing that part of the ascorbic acid in certain plant tissues is in the combined state, records that he has observed a decrease in the ascorbic acid value of cabbage on boiling. Experiments with cabbage carried out here have, however, invariably shown a very considerable increase in ascorbic acid value on heating in a suspension of water on a boiling water bath for 15 minutes in an atmosphere of nitrogen or carbon dioxide. We believe that the oxidase theory accounts partly, but not quantitatively, for the observed increase in value. Thus alcoholic and ethereal extracts, containing no oxidase, also show increase in ascorbic acid value, on being heated for 5 minutes in an atmosphere of nitrogen on a boiling water bath, even when titrations are carried out after addition of formaldehyde or after mercuric acetate treatment, in order to eliminate interfering substances, if any (Table 1).

TABLE 1.

Figures are given in mgm. ascorbic acid per 100 gm. material.

| | Direct titration | | Titration after addition of formaldehyde to the dye | | Titration after mercuric acetate treatment | |
|---|---|---|---|---|---|---|
| | cold | heated | cold | heated | cold | heated |
| Alcoholic extracts | 7·10 | 9·00 | 7·10 | 9·00 | 5·60 | 6·75 |
| | 3·90 | 5·26 | 3·90 | 5·26 | 3·55 | 4·83 |
| | 1·50 | 2·34 | 1·50 | 2·34 | — | — |
| Ethereal extracts | 0 | 0·69 | 0 | 0·69 | 0 | 0·62 |
| | 0 | 1·02 | 0 | 1·02 | 0 | 0·75 |
| | 0 | 0·73 | 0 | 0·73 | 0 | 0·71 |

It will be seen from Table 1 that there is always an increase in the ascorbic acid values of the alcoholic

and ethereal extracts on heating and that, although mercuric acetate lowers the figure (due, according to our observations, not merely to removal of interfering substances but also to a partial loss of ascorbic acid), the increase on heating is significant. In the case of ethereal extracts, the actual figures after heating are low owing to the low solubility of combined ascorbic acid in ether, but it will be observed that before heating the value is nil. Although there are naturally considerable variations in the increase among different cabbage samples, we have observed an increase on heating under our conditions of experiment in all cases without exception.

Further evidence of the presence of combined ascorbic acid in cabbage is provided by experiments (Table II), which show that treatment of cabbage suspensions and extracts with hydrogen sulphide in the hot condition gives a considerably higher value for ascorbic acid than similar treatment at room temperature (25° C.). Cold treatment with hydrogen sulphide, of course, always gives higher values than the simple method of extraction with trichloroacetic acid, owing to the reduction of the considerable quantities of dehydroascorbic acid present, but the difference between the effects of the hot and cold treatments with hydrogen sulphide indicates again the presence of combined ascorbic acid in cabbage, which is split up by heating. This difference can scarcely be explained on the basis of the oxidase theory, as cold treatment with hydrogen sulphide under our conditions of experiment should be capable of reducing all the dehydroascorbic acid produced by the action of the oxidase.

TABLE 2.

Figures are given in mgm. ascorbic acid per 100 gm. material.

| Effect of $H_2S$ at 25° | | Effect of $H_2S$ on boiling water bath |
|---|---|---|
| Aqueous suspensions of cabbage | 64·5 | 72·7 |
| | 67·0 | 73·0 |
| | 67·8 | 81·7 |
| | 62·5 | 71·6 |
| | 64·0 | 73·8 |
| Aqueous extracts of cabbage | 40·0 | 49·5 |
| | 34·6 | 41·6 |
| | 38·5 | 45·2 |
| | 40·0 | 47·2 |
| Alcoholic extracts of cabbage | 12·3 | 20·3 |
| | 9·5 | 15·0 |
| | 21·7 | 35·3 |
| | 24·0 | 30·0 |

Further, we have lately observed that chloroform extracts of dried cabbage, which, as such, give no titre with the indophenol reagent, do so after heating in an aqueous suspension, and at least 75 per cent of this reduction value disappears if the extract, after heating, is subjected to the action of a preparation of ascorbic acid oxidase. This is additional evidence for the view that the reducing substance, produced on heating, is very probably ascorbic acid. This view is being further tested by biological experiments.

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[1] Guha and Pal, NATURE, **137**, 946 (1936).
[2] Mack, NATURE, **138**, 505 (1936).
[3] Levy, NATURE, **138**, 933 (1936).

## Magnetic and Electrical Dimensions

I DOUBT very much whether Sir James Henderson[1] is justified in assuming that the members of the International Committee—and presumably also those of the various congresses and committees which have from time to time reaffirmed the decision that the permeability of space should be regarded as an entity having physical dimensions (the so-called Oslo convention)—were not as fully aware as he himself of "the implications of the adoption of Ampère's theory of magnetism". That their interpretation of these implications differs from his I do not doubt. When I read that "Prof. Howe would have us jettison . . . that wonderful machine which has produced the electromagnetic theory of light, to which is due the discovery of the quantum theory and all the other developments of modern theoretical physics", I can only smile and say that it sounds magnificently foolish, but bears little, if any, relation to the facts of the case. In his paper he showed that it was not only possible, but also very tempting, to assume that permeability is merely a numeric, and that in space the magnetic induction $B$ and the magnetizing force $H$ are one and the same thing. This is, however, a very old assumption; Gauss and Weber made it and on it built the electromagnetic system of units, but they never deceived themselves into thinking that it was anything more than a conventional assumption. Sir James is mistaken in thinking that I object to the mathematical nature of his arguments; on the contrary, my objection is to the assumptions which he introduces. The question is: What are the dimensional relations between $H$ and $B$ in space? I confess in all humility that I do not know, and I put $B/H = \mu_0$, a constant of space analogous to the gravitational or dielectric constants of space. Sir James Henderson, however, says, "According to Ampère's theory $B$ and $H$ are physically identical" and apparently expects the scientific world, which has debated the matter for at least sixty years, to take his word for it.

Prof. W. Cramp asks me what justification I have for writing $\mu \equiv 1/A'$ in preference to $\mu \equiv A'$ as suggested by Sir James Henderson. First, Sir James has shown that putting $\mu \equiv A'$ is tantamount to assuming that both are numerics, that is to say, by doing this one is making an assumption which prejudges the very question to which an answer is being sought. Secondly, by putting $\mu \equiv A'$, the force between two current-carrying coils becomes inversely proportional to the permeability of the medium, which, using $\mu$ in its generally accepted sense, I do not believe. Thirdly, if as Sir James says, "$B$ and $H$ are physically identical" and $\mu \equiv A' \equiv$ a numeric, what has become of the property of space to which Prof. Cramp refers? Surely it has been conjured away, and I feel confident that a little detective work will enable Prof. Cramp to discover at what stage of the performance it was made to vanish.

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April 28.

[1] NATURE, **139**, 676 (April 17, 1937).

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IN the last paragraph of his letter in NATURE of April 17, Sir James Henderson comes down wholeheartedly on the side of the 'one fluid' theory of magnetism, makes $B$ and $H$ of the same dimensions and, by implication, abolishes $\mu_0$.

I, also, reached this conclusion long ago and in 1924 suggested a form of wording for the definitions of these quantities for insertion in the B.S.I. Glossary which was compatible with this point of view. These definitions raised a storm of criticism at the British Association meeting at Oxford in 1926, with the result that (*a*) the offending definitions were removed from the Glossary; and (*b*) there was formed that British Association Committee on Units over which Sir James Henderson himself presides.

It will be interesting (to me at any rate) to see whether other members of the Committee will follow their chairman's lead; and if they do, whether my definitions will be reinstated and whether $\mu_0$ will be jettisoned once and for all.

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### Statistics of Birth-rate Problems

IN NATURE of April 3, p. 565, a passage is quoted from a recent book of mine in which reference is made to the work of Dr. R. Kuczynski in developing statistical methods of dealing with birth-rate problems. While it is obvious to a reader of the book that I was not making any attempt to give a full account of the development of statistical methods in this field, the mention of one name only in the sentence quoted may seem to imply a neglect of the work of others. Therefore, in order to correct any misapprehensions which the quotation of this sentence may have caused, I should like to direct attention to the earlier work of R. Boeckh and of A. J. Lotka, of which an account will be found in the *Annals of the American Academy of Political and Social Service*, November 1936.

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## Points from Foregoing Letters

USING radioactive phosphorus as indicator, a group of investigators from the University of Palermo have determined the relative amounts of inorganic phosphorus (sodium phosphate) taken up by different organs when injected into young rats. Subsequent analysis shows the presence of radioactive organic (lipidic) phosphorus in liver intestine and kidney, in much greater amounts than in muscle or brain. This indicates, according to the authors, that "the participation of the phospholipids . . . results in a complete synthesis starting from inorganic phosphorus".

From observations made in Melbourne on the wave-form of the electromagnetic pulse radiated from lightning flashes (giving rise to atmospherics), Prof. T. H. Laby, F. G. Nicholls, A. F. B. Nickson and Dr. H. C. Webster find evidence of multiple reflections between the earth and an ionized layer at an 'equivalent' height of 78–82 km.

Prof. V. A. Bailey reports observations supporting his theory of the interaction between radio waves. Several European stations have collaborated in sending out suitable radiations. Interaction was observed in one case, caused by a gyro-station with a radiated power of only five kilowatts. Comparative tests with London National and London Regional show the existence of resonance in interaction.

Dr. M. S. Vallarta states that the constant intensity of cosmic radiation beyond a certain latitude may be accounted for by a magnetic action of the sun, and that the value of its magnetic moment calculated from the latitude effect leads to a value of the field intensity at the sun's surface in good agreement with that found by Hale and his collaborators. Two observable consequences of this interpretation are discussed.

That certain spectrographic lines and bands of interstellar origin observed by Merrill may be due to the presence of molecules ($Na_2$, NaK) is suggested by Prof. M. N. Saha. He points out that 'temperature' in interstellar space is near the absolute zero, and that only such states of atoms and ions occur there as have infinitely long life.

G. C. E. B. Hulbert and Prof. C. M. Yonge give reasons for inferring that the function of the osphradium in gastropods is to estimate the amount of sediment carried into the mantle cavity by the water currents created by the lateral cilia on the gills.

Drs. Donald and Alistair Gunn and Miss P. M. Jenkin have collected records which, they state, show that there is no lunar periodicity in human menstruation.

By irradiating (with radium) cells *in vitro* held at a temperature of 6° C., so that active cell life is inhibited, and afterwards allowing the cultures to develop, Prof. L. Halberstädter and L. Doljanski have succeeded in establishing a numerical relation between the amount of growth inhibition and the dose of rays applied.

A number of elements (molybdenum, silver, bromine, antimony, etc.) when bombarded with neutrons are found by F. A. Heyn to give radioactive substances with half-periods corresponding to those obtained when gamma rays are used. This, he points out, is additional evidence that a neutron entering the atomic nucleus may expel two neutrons with the production of a radioactive body.

The absorption spectra, and hence the optical rotatory power, of cobaltammines are, according to Messrs. C. H. Johnson and N. H. Poynton, affected in a specific manner by substitution of $^2H$ for $^1H$ in constituent $NH_3$ or $NH_2$ radicals. Measurements of optical rotation can thus decide the isotopic composition of a complex ion or of a solvent in equilibrium with it.

Prof. B. C. Guha and J. C. Pal state that alcoholic and ethereal extracts of cabbage give a higher ascorbic acid value on heating in nitrogen, even if the estimation is carried out after mercuric acetate treatment. Further evidence is offered for the existence of combined ascorbic acid in cabbage. The dye-reducing value obtained after heating chloroform extracts of cabbage disappears in large measure by the action of ascorbic acid oxidase, suggesting that the substance produced on heating is ascorbic acid.

# Research Items

## Bronzes from Iran and Elsewhere

AMONG a number of bronzes from Iran, Iraq and Asia Minor selected because they represent types not hitherto in the British Museum (Bloomsbury), and figured and described by Mr. Sidney Smith in *Brit. Mus. Quarterly*, **11**, 2, are a number from Luristan, including an amulet with a suspension ring, which takes the form of a conventionalized 'naked goddess', such as were made in stone and clay at a very early period in Assyria, and similar to a type found in Crete. A small mace-head with bosses is of a type hitherto only known in stone. Each of the bosses is pierced, as if sockets were made to hold studs, but if so it is difficult to conjecture their use. An unusual object is an elaborate holder or *pelle d'offrandes*, of which the form imitates either a wheeled-cart or a sledge, the wheels or runners being replaced by four legs. Three animals stand facing the rear of the cart on an edge some four inches long by ¾ inch broad above the cart, the bottom of which is sunk nearly an inch and is only 2¼ inches long, terminated by an upturned edge ¼ inch inside the termination of the sides. The long shaft—eight inches—which turns in a socket as long as the upper edge, carries two animals facing in different directions, has a ring-attachment which serves as a support, and rises to a yoke, cast separately, the three ends thus made being shaped into unidentifiable animal heads. These bronzes are subject to the doubts about the dates of bronzes from Luristan. A fragment of a concave-sided vessel from Nihawand seems to have been chased over a bitumen ground, as it is not *repoussé*. The faces of the chased figures appear noseless with pointed chins. A harp seems to have eight strings, while a rectangular object is also doubtless a musical instrument and has been identified as an *adapu*, beaten with the hand. A curious object held by a broken seated figure seems to be a misshapen fish. A 'spectacle' amulet from Asia Minor, like others of the same type in ancient times, represented the convolutions of the intestines, and in modern Egypt is a prophylactic against the pains of childbirth.

## Zuni Mythology

INTENSIVE study of folk-lore has tended to be neglected for a variety of reasons; but Ruth Benedict points out ("Zuni Mythology". *Columbia University Contributions to Anthropology*, **21**, 2 vols.) that Zuni folk-lore affords excellent material for such study, in that a large body of tales has been recorded over a considerable period, indeed more than fifty years, the culture is well known, and in contrast to almost all the other tribes of North America, folk-lore among the Zuni is not moribund. This last-named factor brings out the importance of allowing for variation. In considering the relation of the themes which Zuni folk-lore elaborates in relation to culture, a number of points emerge. No folk-tale is generic. It always relates to a particular people, livelihood, social organization and religion. The final form is dependent on culture. Survivals belong to a dead culture, as in European folk-lore, and the function of myth cannot be studied in such cases. A living folk-lore reflects current use, although there is a lag. Also something must be allowed for idealism and the conventionalization of a Golden Age, which explain the discrepancy between story and fact. A discrepancy of constant occurrence in Zuni folk-lore is the occurrence of polygamy. While all other Indians recognize polygamy and sometimes polyandry, the Zuni are monogamous. This probably represents an element analogous to the fairy element in other systems, the grandiose wish and day dream. Other contrasts are compensatory. For example, the abandonment of children is alien to Zuni culture; and yet it is a popular feature in the folk-tale. This is because the interest centres on the child, and in the story the parents are put to shame. There is no recognition of suicide in Zuni culture, or of taking vengeance on an unfaithful spouse. So in the tale the Apache are summoned, as destruction must overwhelm innocent and guilty alike. An interesting feature is the position of women in sexual matters. The women are regarded as the pursuers; the male is bashful and hangs back.

## Episternal Bones in Man

IN 1820, Bécland first directed attention to the occasional presence of episternal bones in man, but they were more fully described eighteen years later by Breschet, to whom subsequent writers have generally given the credit for their discovery. Since then they have been recorded by numerous workers, and a detailed investigation of 2,218 human and 107 anthropoid sterna has enabled W. M. Cobb (*J. Anat.*, **71**, Jan. 1937) to review the subject. Ossa suprasternalia were found in 6·8 per cent of 544 adult whites and 2·2 per cent of adult negroes. None was found in the 107 anthropoids. They appear to be homologous with the rudiments of the epicoracoids of the primitive shoulder girdle. The human sternum with a convex manubrial border and ossa sternalia is to be regarded as the most primitive condition, while that with no ossa and a convex border the most advanced. Since all the anthropoids studied were of this latter type, they are in this respect more advanced than human beings.

## Mysids and Euphausiids of the Great Barrier Reef

PROF. W. M. TATTERSALL, in his memoir on Mysidacea and Euphausiacea (Great Barrier Reef Expedition 1928–29. Scientific Reports, vol. 5, No. 4; 1936), records seventeen planktonic mysids and six species of bottom forms, and a small collection of euphausiids comprising sixteen species, two of which are larval forms which could not be identified. The occurrence and seasonal distribution of both groups have been discussed in a separate report (vol. 2, No. 8). From these observations it is shown that the night hauls of plankton contain numerous mysids which are scarce during the daytime, and it is probably that they live at the bottom and only become planktonic by night. The new genus *Pseudomysidetes* is created for the new species *P. russelli*, closely related to Mysidetes, and three other species are described as new to science. The euphausiids are specially interesting as they form apparently the first collection made from this locality. Twelve of

the fourteen identified species were captured by the *Siboga* Expedition, which operated mainly in the Dutch East Indies, and the remaining two are tropical species which might have been expected in the same area and actually occur in other parts of the Pacific. All are oceanic, except *Pseudeuphausia latifrons* which is a shallow-water coastal form, widely distributed in the Pacific, and this species is the dominant one and is the only form characteristic of the shallow lagoon area inside the reef. A fairly complete series of larval stages enabled the life-history to be followed; this is closely related to that of *Nyctiphanes* and suggests that *Pseudeuphausia* is nearer to *Nyctiphanes* than to *Euphausia*, under which genus it was first described.

### Locusts in Malaya

In a recent bulletin (No. 18, Dept. Agric., Scientific Series, Straits Settlements and Federated Malay States), Messrs. G. H. Corbett and N. C. E. Miller discuss the incidence of two species of locusts in Malaya. As regards the oriental migratory locust (*Locusta migratoria manilensis*) it appears that there is no clear evidence that this insect is indigenous to Malaya. The regular absence of its solitary phase, and the fact that swarms are comparatively infrequent, point to this conclusion. Since Malaya has only been visited twice by swarms of *Locusta* during the past twenty-four years, this fact seems to be due to the distance which swarms have to travel in order to reach that territory. The suggested country of origin is Borneo, and it is considered quite likely that swarms may visit Malaya when outbreaks are in progress in other countries of the Pacific. The second species—the Bombay locust (*Patanga succinta*)—appears to cause negligible damage, but the occurrence of the insect in its solitary phase suggests that it may be indigenous.

### Metabolism and Growth-Responses of the Cucumber

Modern research has not yet made it clear to what extent such growth responses as flowering and fruiting are caused by, or are themselves the cause of, variations in chemical composition of the plant. There is an undoubted relation between the two, and a paper by Dr. R. B. Dearborn (Cornell Univ. Agr. Exp. Sta. Mem. 192, Ithaca, N.Y., July 1936) presents a very detailed contribution to our knowledge in this field. Cucumber plants were grown under conditions of high, and of low, nitrogen supply, whilst the composition of normal bearing plants was compared with that of plants which had their flowers or fruits removed. It was found that fruiting plants had a higher rate of vegetative growth and made more plant material for 10–14 days after pollination, than deflorated plants. Pollination therefore appears to exert a stimulus upon the general growth. The development of fruit had less effect upon the plant when the nitrogen supply was adequate, than when it was low. Amino and amide nitrogen accumulated in deflorated plants, so that the utilization of these fractions is in all probability impeded by the absence of fruit. Carbohydrates accumulated more in low-nitrogen plants than in those with higher nitrogen metabolism. Detailed estimations of the various fractions of carbohydrate and nitrogen are to be found in the paper, and the results show a definite relation between certain of these fractions and the type of growth. They do not, however, determine whether this relation is causal or subjective.

### Powdery Mildew of Cucurbitaceæ in Egypt

The fungus *Erisyphe cichoracearum*, which causes a powdery mildew of melons, cucumbers and other members of the Cucurbitaceæ, is very destructive to these crops in Egypt. Dr. Amin Fikry has published a detailed account of the disease (*Bull.* 175, Tech. and Scientif. Serv., Min. Agric., Egypt, Govt. Press, Bulâq, Cairo, 1936. P.T. 7), particularly with the view of controlling it. Powdery mildew is distributed widely throughout the country, and freely attacks all cucurbitaceous crops except water melon, which may, however, be attacked severely under conditions of high relative humidity. Dusting infected plants with flowers of sulphur was found to be the most satisfactory and practical means of control, though spraying with Burgundy mixture was also effective. A simple apparatus, which applied the sulphur by shaking it through a muslin cloth, was designed, and appeared to be very effective—superior, even, to mechanical dusters. Striking increases of crop followed two applications made when the fungus first appeared, but very little benefit accrued when the sulphur was applied either as a precautionary measure, or when the disease was well established. The bulletin is well illustrated by twenty-four plates, which portray symptoms on different plant hosts, and show various methods of control.

### Native Agriculture in Northern Rhodesia

The Ecological Survey of Northern Rhodesia, which was inaugurated in 1931, was faced with the difficult problem of evolving a quick and sound method of mapping and classifying large areas of country in order to provide a basis for native agricultural development. To have employed a large-scale soil survey would have been both slow and costly. Regional or geographic survey would be unsatisfactory without soil or geological information, which was not available. Vegetation survey, if conducted with due allowance for climatic variation and for changes induced by biotic factors, was found to provide the quickest efficient means of land classification. Mr. Trapnell (*Bull. Misc. Inform., Kew*, 1, 1937), the ecologist of the Survey, describes in detail the method he employed. A direct correlation between vegetation type and native agricultural practice was soon established. The degree of correlation obtained between soil and vegetation type, the reasons for lack of correlation where found, and the type of mapping unit which emerged as desirable for agricultural purposes are explained. The rest of the paper is concerned with agricultural aspects.

### Directional Properties in Rolled Brass Strip

At the annual meeting of the Institute of Metals (March 1937), a paper by Dr. Maurice Cook dealt with a matter of profound importance to producers and users of rolled brass strip. It is shown that the tensile strength of such strip, when the reduction has been sufficient to induce a directional effect, is greatest, and the ductility least, when tested in a direction normal to that of rolling, whilst in the direction of rolling itself the converse obtains. When such cold-rolled strip is annealed, it may still show directional properties which are revealed both by tensile tests and by the occurrence of 'ears' or waves on the edges of cups pressed from such strip. In annealed strip which shows a variation of properties in different directions, the tensile strength is least, and the ductility greatest, when tested at an angle of

45° to the direction of rolling, and it is in this position that the 'ears' are formed. The extent to which 'directionality' exists in rolled and annealed strip is determined largely by the conditions of the penultimate and final annealing treatments and by the degree of the reduction by rolling between them. A study of the orientation of the twinning planes in rolled and annealed 70 : 30 brass strip which shows an appreciable variation of properties in different directions indicates that the frequency of orientation of the twinning planes is least at 45° to the direction of rolling. In the case of strip which does not show directional properties, the twinning planes occur fortuitously in the sample.

### Activity Coefficients from Cells with Transference

T. SHEDLOVSKY and D. A. MacInnes (*J. Amer. Chem. Soc.*, **59**, 503; 1937) have measured the activity coefficients of potassium chloride and calcium chloride by means of potential measurements of cells of the type:

$$\mathrm{Ag}\ ;\ \mathrm{AgCl},\ \mathrm{MCl}(c_1)\ :\ \mathrm{MCl}(c_2),\ \mathrm{AgCl}\ ;\ \mathrm{Ag}$$

in which M represents the cation. The calculations involved the transport number $t$ of the cation through the equation

$$-E = 2(RT/F)\int_1^2 t\ \mathrm{d}\log c f,$$

where $f$ is the activity coefficient, for the potassium chloride, and the corresponding equation with the factor $3RT/2F$, instead of $2RT/F$, in the case of calcium chloride. The values of $t$ must be known, and accurate values for the two electrolytes over a range of concentrations have recently been measured by Longswort hand by MacInnes and Dole. It was found that the simple Debye–Hückel equation: $-\log f = \alpha\sqrt{c}/(1+\beta\sqrt{c})$ reproduced the results with great precision over the range of concentrations 0·005–0·2 for $c_2(c_1 = 0{\cdot}1)$—the actual measurements extended to $c_2 = 3{\cdot}0$— and 0·0018–0·03 for calcium chloride (actual measurements up to $c_2 = 0{\cdot}096$; $c_1 = 0{\cdot}05$). The constant $\beta$ involves the distance of closest approach of the ions, and for potassium chloride and calcium chloride this distance was calculated as 4·1 and 5·2 A., respectively. For higher concentrations, agreement was obtained for the former up to $c_2 = 3$ and for the latter for $c_2 = 0{\cdot}1$, by modified equations obtained by subtracting terms in $c\log c$ and $c$, respectively, from the simple equation. The results with calcium chloride are of particular interest, since they show that the Debye–Hückel equation in its simplest form applies to the dilute solutions of this unsymmetrical type of electrolyte, the distance of closest approach being sufficiently large to make the higher terms of the La Mer equation negligible.

### Estimation of Arsenites, Arsenates, Selenites, and Selenates

IN a communication read before the Czech Academy of Sciences on December 10, 1936, and published in the Academy's *Bulletin International* (1937, p. 1) Prof. J. Milbauer and Dr. J. Vodražka describe a method of estimating arsenites, arsenates, selenites and selenates in mixtures containing all four salts. Molybdic acid serves to detect arsenates in such a mixture, but cannot be used for quantitative estimations since selenium compounds are found to be occluded in the arsenomolybdate precipitate. No such occlusion occurs when arsenates are precipitated as magnesium ammonium arsenate, $MgNH_4AsO_4.6H_2O$, on adding ammoniacal magnesium solutions to the mixture. The precipitate is converted into magnesium pyroarsenate, $Mg_2As_2O_7$, and weighed as such. To determine the arsenite a weighed amount of the mixture is oxidized (nitric acid, bromine, sulphuric acid and bromine, potassium chlorate, perchlorate or bromate can be used) to arsenate and the estimation carried out as indicated above. Selenates can be estimated, in absence of chloride, by means of barium perchlorate, which precipitates barium selenate in the presence of perchloric acid. Selenites can then be determined by means of barium perchlorate after suitable oxidation. Should hydrochloric acid or a chloride be present, the total selenium is estimated by reduction with hydrazine sulphate, which yields elementary selenium.

### Fuel Briquetting

THE agglomeration of powdery material—especially fuels and ores—is a technical problem of world-wide interest. Its importance is not felt in full measure in Great Britain, favoured as it is by well-distributed supplies of excellent coal. In many countries, fuels are lacking or available supplies consist of low-grade, non-coking or pulverulent material to which the briquetting process is applicable. Accordingly, we find that the technique of briquetting lignite has been highly developed in Central Europe. South Wales has found a Continental market for its anthracite dust in the form of briquettes. In North America the quest of an anthracite-substitute has produced an enormous patent literature. The problem is essentially the production of a suitable binder—preferably smokeless—waterproof, furnishing a briquette which is not only mechanically strong enough for storage and handling before use but also during the process of combustion. The state of the art can be realized from a report on fuel briquetting by R. A. Strong, E. Swartzman and E. J. Burrough issued by the Canadian Bureau of Mines, Ottawa (25 cents, pp. 100). It contains a critical bibliography, and is a welcome contribution to a branch of technology imperfectly supplied with literature.

### The Orbit of the Binary Star, Σ 2026

IN *Mon. Not. Roy. Astro. Soc.*, (**97**, 3, Jan. 1937), Dr. R. v. d. R. Woolley and Mr. L. S. T. Symms contribute a paper in which they describe their method for improving the orbit of this binary, which was discovered by Struve in 1830. Since Comstock published his orbit in 1918, very satisfactory observations have been made, and these have been used to compute an orbit which will probably not be improved for a great many years. The attempt to compute an orbit by Russell's method met with little success, and discordances as large as 15° in position-angle were found when an ephemeris was computed from preliminary curves. Arbitrary alterations were then made in the elements until these discordances were reduced to ± 3·5° in the observed minus computed position-angle, and differential equations were applied to improve the elements of the orbit. A detailed description follows showing the procedure adopted, with the ten places selected as representing the observations satisfactorily. The results show that the period is 680 years, the semi-axis major 3·04″, and the inclination ± 130·6°. It is observed that much of the work in the northern hemisphere which needs to be done on double star orbits is of the nature of improving existing orbits with the use of later observations, and for this purpose the differential method of Innes and van den Bos is well suited.

# Mellon Institute of Industrial Research

THE new building of the Mellon Institute of Industrial Research in the University of Pittsburgh was dedicated on May 6, addresses being given by three Nobel laureates, Dr. Irving Langmuir, Dr. H. C. Urey, and Dr. W. P. Murphy. On the following day, a symposium on recent progress in science was held, to which Dr. G. O. Curme, Dr. F. B. Jewett, Sir Frederick Banting and Dr. W. W. G. Maclachlan contributed.

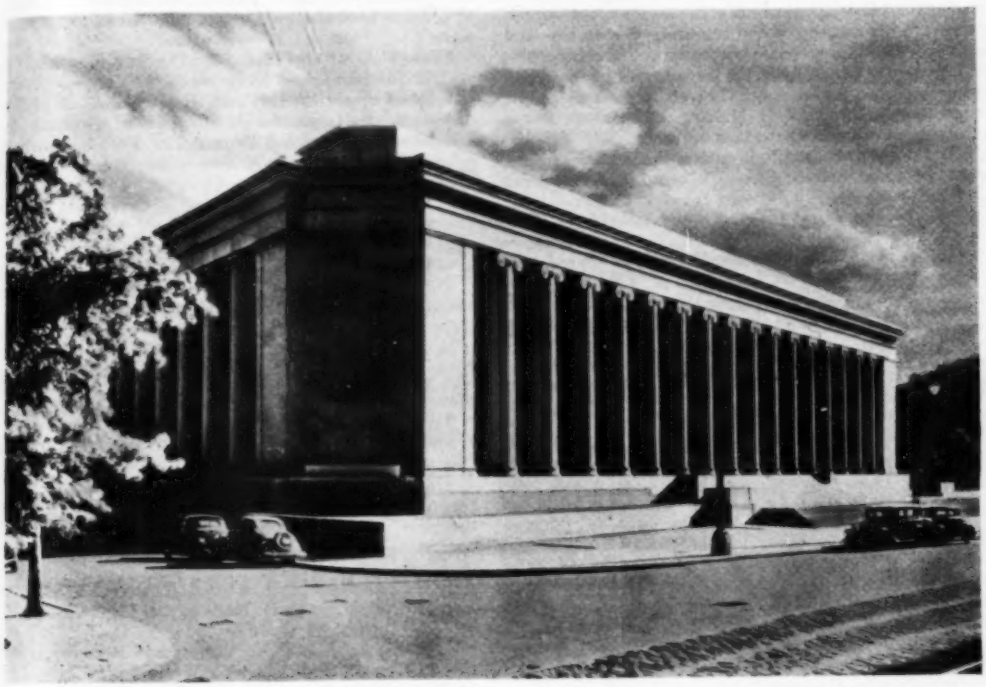

Fig. 1.
NEW BUILDING OF MELLON INSTITUTE, PITTSBURGH, PA.

The new Institute is the gift of the late Richard R. Mellon and his brother Andrew W. Mellon, formerly Secretary of the U.S.A. Treasury. Its origin is to be traced to Prof. Robert Kennedy Duncan's scheme of industrial fellowships, under which industrialists co-operate in the prosecution of specific researches. This scheme was first put into operation in 1907 in the University of Kansas and transferred to Pittsburgh in 1911. The Institute under its present name was founded in 1913 by the Mellon Brothers, who authorized Duncan to design a special building with adequate laboratory facilities. Duncan died prematurely in 1914 and the original building was dedicated in the following year, with Dr. Raymond F. Bacon as its first director. He was succeeded in 1921 by the present director, Dr. Edward R. Weidlein. An important development, with which Duncan would have been in full sympathy, was the establishment in 1924 of the Department of Research in Pure Chemistry.

Details of the scheme of industrial fellowships having been given from time to time in NATURE (see particularly NATURE, May 23, 1936, p. 855), a summary of the present position and a brief description of the new building will suffice to commemorate the official opening of the largest building in the world dedicated to scientific research. The money appropriated by donors in support of industrial fellowships has amounted in the past twenty-six years to 11,478,406 dollars. In the financial year ending March 1, 1937, appropriations by donors were 816,315 dollars, and 69 fellowships have been in operation, employing 185 scientific workers and engineers. The Institute's contributions to the literature of science include 19 books, 143 bulletins, 744 research reports, and 1,117 papers published in journals; and 669 U.S. patents have been granted. Since 1911, 1,150 fellowships have been established in 275 technological subjects, and 650 processes or products have been invented or developed. In ten instances, new industries have resulted. From 1911 until 1935,

no less than 777 scientific workers, having completed the work of their fellowships, have entered the field of manufacture or teaching, and this forms not the least valuable contribution to the promotion of science and industry. In recent years, the Institute has greatly developed its work of a more purely scientific character or bearing on public health. Its investigations on smoke abatement, dental caries, and anti-pneumococcic serum are examples.

With a view to simplicity, beauty and inspiration, the new building was designed in the Greek style (Fig. 1) with a relatively low elevation, three storeys being below ground level. The building has a capacity of 6¼ million cubic feet. Its colonnades have a total of sixty-two columns, each shaft—a single block of stone—weighing approximately 60 tons, of which twelve are on the south frontage, sixteen on the east and west and eighteen on the north. At the corners are impressive piers. Models were found in the small temple of Nike Apteros on the Acropolis and in the temple at Sardis in Asia Minor. On three sides a flight of steps leads up to the building. The fifth to eighth floors are devoted entirely to laboratories, most of the space being occupied by the two types of laboratory adopted by the Institute as standard. Doors connecting the laboratories are of aluminium adorned with alchemical symbols.

In accepting in 1935 the Chemical Industry Medal of the Society of Chemical Industry, Dr. Weidlein, the director, said that his task at the Institute had been to assist in infusing science into technology, particularly the chemical industry. This task had two aspects—to convince manufacturing organizations of the functions of scientific research and research management in industry, and to encourage in the public a greater appreciation of the value of science. Thanks to the work of the industrial fellows, the Institute formed a strong link between the world of science and the industries. His concluding words were :

"What about the future ? I believe that all of us at the Institute will have much greater encouragement and opportunities and that we shall be able to do many more useful things when we have the advantage of working in our new building with its splendid facilities for research in pure as well as applied science."

## Kew's Contribution to Empire Botany

VISITORS to the Royal Botanic Gardens, Kew, who usually see only the Gardens and Museums, can have little idea of the great role that the Herbarium near the Main Gate has played in the botanical service of the Empire. Since the Herbarium was founded in 1852, members of the staff have, independently and collectively, and in association with other botanists, accomplished a vast amount of floristic work. In order to show the extent of this to the numerous visitors, particularly from overseas, who will no doubt visit the Gardens during the Coronation period, a special exhibit has been arranged in No. 3 Museum. In a large glass case there has been placed a selection of works prepared either wholly by, or with the assistance of, the scientific staff of the Herbarium and Museums.

The general books shown include the classical work of G. Bentham and J. D. Hooker, the "Genera Plantarum", 1862–83, which has been and is still used by botanists in all parts of the world. Next in order is the "Index Kewensis", a work of universal importance compiled at the expense of Charles Darwin, under the direction of Sir J. D. Hooker, by the late B. Daydon Jackson, and continued by various members of the staff. This gives references to the original descriptions of all known species of flowering plants. Alongside is the great index of plant illustrations, the "Index Londinensis", edited by the late O. Stapf. Besides these are the "Hortus Kewensis" of W. Aiton, 1789, which records the species of plants in cultivation at Kew when still a 'royal garden' ; the *Botanical Magazine*, the oldest of botanical periodicals, commenced in 1787, and still prepared at Kew, but since 1922 the property of the Royal Horticultural Society ; the *Kew Bulletin*, which this year attains its golden jubilee, having been started in 1887 ; and Hooker's "Icones Plantarum", which last year attained its centenary, and which provides a medium for the illustration of plants of exceptional botanical interest.

The botany of the British Isles is represented by Hooker's "Students' Flora" (1870) and by the "British Flora" of G. Bentham (ed. 1, 1858).

The vegetation of much of China and Tibet is recorded in Forbes and Hemsley's "Index Floræ Sinensis" (1886–1905), Bentham's "Flora Hongkongensis" (1861), and Dunn and Tutcher's "Flora of Hong Kong" (1912).

India has been well catered for by the "Flora of British India", by J. D. Hooker and others (1872–97), and the "Flora of Bombay", by T. Cook (1901–08), the "Flora Simlensis", by Collett and Hemsley (1902), the "Flora of the Upper Gangetic Plain", by J. F. Duthie (1903–29) ; "Bengal Plants" by D. Prain (1903) ; and the "Flora of Madras", by J. S. Gamble, completed by C. E. C. Fischer (1915–36). The forestry of India is dealt with in "Indian Trees", by D. Brandis (1907), and the "Forest Flora of the Andaman Islands", by C. E. Parkinson (1923).

The "Flora of the Malay Peninsula" (1922–25) was a heavy undertaking by one botanist, H. N. Ridley ; and the "Enumeration of Siamese Plants" (1925– ) by the late W. G. Craib, is being continued.

The continent of Australia was early provided for by G. Bentham's fundamental work, the "Flora Australiensis" (1863–78), and J. D. Hooker's "Flora of Tasmania" (1860), whilst the "New Zealand Flora" (1864–77), by J. D. Hooker, and the "Illustrations of the New Zealand Flora" (1914) by Cheeseman, assisted by W. B. Hemsley, have done much for the botany of that Dominion. J. D. Hooker's "Flora Antarctica" (1847) is a classical work for that region.

Africa has always taken a first place in the activities of the Kew Herbarium, and several works of considerable magnitude have been issued dealing with

its flora. The "Flora of Tropical Africa" was begun by D. Oliver in 1868, and has been carried on by many botanists, part of the last family, the Gramineæ, commenced by O. Stapf and now being continued by C. E. Hubbard, only remaining to complete the huge task. The work of editing this great undertaking has been carried out by successive directors of Kew, Sir William T. Thiselton-Dyer, Sir David Prain, and Sir Arthur W. Hill, and part of the Euphorbiaceæ was contributed by Sir David Prain.

The "Flora of West Tropical Africa" (1927–36), by J. Hutchinson and J. M. Dalziel, is the first regional illustrated flora of the tropical part of the Continent; its "Economic Appendix" by J. M. Dalziel provides full information on the uses of West African plants. Smaller areas are dealt with in the "Flora of Liberia" (1906), by O. Stapf (in Johnston, "Liberia"); "Trees and Shrubs of Sierra Leone" (1916) by C. E. Lane Poole; "Gold Coast Trees and Shrubs" (1913), T. F. Chipp; "Nigerian Trees" (1925), H. V. Lely; "Flora of the Sudan" (1929), A. F. Broun and R. E. Massey, and its companion volume of illustrations by G. M. Crowfoot (1929); "Trees of Kenya Colony" (1926), E. Battiscombe; "East African Grasses" (1926–27), by C. E. Hubbard.

The islands of Mauritius and the Seychelles were provided for in J. G. Baker's "Flora" (1877), and latterly the "Seychelles Flora" has been enumerated by V. S. Summerhayes.

The immense task of describing the rich and varied flora of what is now the Union of South Africa, begun by Harvey and Sonder in 1859, the "Flora Capensis", was continued by the Kew staff and others and completed in 1935. As in the case of the "Flora of Tropical Africa", the editorship has been in the hands of successive directors of Kew, Sir David Prain and Sir Arthur Hill also contributing largely to the taxonomic work. The "Flora of the Transvaal" (parts 1 and 2, 1926–32), by J. Burtt Davy, is the first of the regional descriptive floras of South Africa. The descriptions for Mrs. E. F. Vallentin's "Illustrations of the Flowering Plants and Ferns of the Falkland Islands" were provided by Mrs. E. M. Cotton.

A. H. R. Grisebach's "Flora of the British West Indian Islands" was written in association with Kew; and the "Flora of Trinidad" (1928– ), by Williams and Cheesman, is also being prepared in close collaboration with Kew.

Among the general works by individual Kew botanists are the "Synopsis Filicum" (1868), of W. J. Hooker and J. G. Baker; the "Fern Allies" (1887), by J. G. Baker; "British Fungi" (1906), G. Massee; "Diseases of Cultivated Plants and Trees" (1910), G. Massee; and J. Hutchinson's new phylogenetic classification in his "Families of Flowering Plants" (1926; 1935). "Plant Life in the Balkan Peninsula", W. B. Turrill (1929), is an intensive study of a special area.

Researches in sixteenth century botany are represented by the "Herbal of Otto Brunfels", by T. A. Sprague (1928), and the "Herbal of Leonhart Fuchs", by T. A. Sprague and E. Nelmes (1931).

Applied botany is the subject of J. Smith's "Dictionary of Economic Plants" (1882), and his "Domestic Botany" (1871); G. Watt's monumental work, "A Dictionary of the Economic Products of India" (1889–93(6)), and its abridgment, "The Commercial Products of India" (1908); the "Economic Products of the Malay Peninsula" (1935), I. H. Burkill; "Useful Plants of Nigeria" (1908–22), by J. H. Holland; "Tropical Agriculture" (1929), revised by J. H. Holland; "Sorghum" (1936), J. D. Snowden; "Crop Plants of the British Empire" (1936), by H. C. Sampson.

Among the more important books on horticulture and forestry are the "Dictionary of Gardening" (1884–88), by G. Nicholson; "The Trees of Great Britain and Ireland", H. J. Elwes and A. Henry 1905–13); "Trees and Shrubs Hardy in the British Isles" (1921), by W. J. Bean; "Rhododendrons" (1930), by J. Hutchinson (Kew), A. Rehder and H. Tagg (published by the Rhododendron Society); "Coniferæ" (1923), by W. Dallimore and A. Bruce Jackson, and the periodical, the *Orchid Review* (1893– ), founded and edited for many years by the late R. A. Rolfe. The history of the Gardens is dealt with in "The Royal Botanic Gardens, Kew" (1908), by W. J. Bean.

This list does not include, of course, the numerous smaller papers in scientific journals to which the Kew staff has so largely contributed.

## Calculating Machines in Scientific Computing

SCIENTIFIC computing has been materially aided of late years by the development of calculating machines, a development in which scientific workers themselves have had a say. We may instance the use of the modern Brunsviga, with its split register and automatic transfer features, in statistical calculations; the application by Dr. L. J. Comrie of the Brunsviga twin 13z to the Hartmann formula for the reduction of prismatic spectrograms; the use of the Burroughs machine, and later the National Cash Register machine, in the Nautical Almanac Office for finite differencing and integration; the demonstration recently given at Cambridge of the application of the Hollerith rolling-total tabulator for the same purpose, and for general statistical calculations; the machine invented by Mr. R. R. Mallock at Cambridge for solving simultaneous equations; and the Bush machine developed at the Massachusetts Institute of Technology for the numerical solution of differential equations, and since installed by Prof. D. R. Hartree at Manchester.

For some years, the Mathematical Tables Committee of the British Association has concentrated on the production of new tables by means of subtabulation on its "National" machine, a process which has revolutionized the art of table-making; the incidental advantage of having clean type copy produced by the machine for the printer has largely eliminated copying and setting errors. Checking by means of mechanical differencing of tables is equally

easy. With regard to the Hollerith, the spectacular production of a table of a polynomial function by feeding the machine with blank cards appealed to many at the Cambridge demonstration, while so far as capacity for work is concerned, it may be mentioned that in a recent agricultural statistical investigation, two Cambridge workers produced a million products in six weeks, that is, at the rate of one product a second.

Expensive machines are not readily available to the ordinary scientific worker, and this lends interest to the announcement that Dr. Comrie, formerly superintendent of H.M. Nautical Almanac Office, to whom much of the above mentioned development is due, has set up at 131 Maze Hill, Blackheath, London, S.E.3, a professional "Scientific Computing Service". Dr. Comrie offers his services for (1) scientific calculations generally, and particularly those where mechanical computation and mass production methods may be employed; (2) table-making; (3) purchase and use of calculating machines and mathematical tables; (4) instruction in the art of mechanical computing; (5) press work; and (6) lectures on calculating machines or on computing. He has at his command a variety of machines, including a "National" and Hollerith equipment. As the former is expensive to buy and the latter to hire, here is a means whereby the scientific worker may get computation jobs done efficiently at reasonable rates.

An interesting announcement from Cambridge relates to the proposed establishment of a computing laboratory in the mathematical faculty. The immediate intention is to acquire a Bush integrating machine and the Mallock equation solver, but other machines will be added from time to time, and a wide view is being taken of the service that can be rendered to Cambridge by the establishment of such a laboratory. Besides the applied mathematicians, we can envisage statisticians, economists, biologists, psychologists and others being eager to avail themselves of the specialized equipment that will no doubt be available in time, in order to supplement their existing computational resources. The capital cost of the proposed installation is of the order of £10,000, and it is anticipated that an annual charge of £1,000 per annum will fall to be met by the University, to include maintenance and replacement of machines, and salaries. The scheme has been approved, and the laboratory should be in existence by the opening of the academic year in 1938.

## Hybrid Vigour in Plants

INCREASED vigour over either parent of the product of the cross between two inbred lines has been frequently reported in plant breeding and, through vegetative propagation, efforts have been made, especially with trees, to make practical use of the phenomenon. It is usually explained, in Mendelian terminology, as the result of association of several genes for size which had been isolated in either parent, and subsequent loss of vigour in succeeding generations is attributed to segregation. There has been little analysis, however, of the factors contributing to the heterosis or hybrid vigour during the development of the hybrid, so that considerable interest is attached to a recent series of papers by Dr. Eric Ashby, which have brought to light some most unexpected features of this process in specific cases.

In certain strains of maize[1] and in two cases with tomato strains[2] where the hybrid showed greater weight and dry weight, greater height, more leaves and larger leaf area than either parent, analysis of these differences showed no appreciable difference between hybrid and parent in relative rates of growth or of dry weight increase, of rates of production of leaves and new leaf area or of photosynthetic efficiency. Cell size in hybrid and parent also seemed approximately the same, but the embryo of the resting seed seemed larger in all cases.

The only possible conclusion from these results would seem to be that the organization of the growing shoot of the hybrid is upon a larger scale. Embryo and shoot apex form cells more rapidly, but this does not result in a quicker release of leaf primordia from the shoot apex because the whole plan of shoot organization, though still that characteristic of the species, is built upon a larger scale. More cells must accumulate at the apex before the new leaf primordium must separate. Naturally, therefore, when it arises, this primordium is planned on a larger scale from the outset, presumably its procambial and vascular strands are commensurately larger and it grows into a larger leaf, though individual cells, in their metabolic and photosynthetic efficiency, correspond with those of the parent forms.

Dr. Ashby speaks of larger primordia in the seed, but the term is usually applied to leaf primordia, and in the embryo of the tomato, apart from cotyledons, leaf primordia will scarcely be manifest yet. It would seem that the comparison is rather upon the scale of organization of the meristematic aggregate in the hybrid shoot; planned on a more generous scale, it yet maintains the rate of leaf development of the parent, so that its growth must mean a larger number of meristematic cells maintained in full activity at any moment, therefore more cell divisions and the growth organization of the species maintained at its usual *tempo* but on a larger scale.

Dr. Ashby's studies are therefore full of significance in relation to the problem of shoot organization in the higher plant, as well as in connexion with the genetic explanation of hybrid vigour. Dr. Ashby points out that his results are not in accordance with the usual interpretation given to the linkage of genes in the $F_1$ generation, but there is as yet so little information as to the way in which the gene is geared into the machinery of development that it is early to say whether the conventional explanation in terms of genes can be applied to the machinery now revealed as operating in the development of the hybrid.

[1] *Ann. Bot.*, **44** (1930) and **46** (1932).
[2] *Ann. Bot.*, N.S., **1**, 11–42 (1937).

## Science News a Century Ago

### Population of England and Wales

In a paper read to the Statistical Society on May 15, 1837, entitled "On the Movement of the Populations of England and Sweden throughout seventy-five Years, ending with 1830", Mr. T. R. Edmonds made many observations of interest to statisticians and physiologists. In the course of his remarks, he said that in the majority of European nations the annual births amounted to 1 in 30 and the annual deaths to 1 in 40 of the total population. The highest birth-rate was about 1 in 23 and the lowest about 1 in 33. The highest rate of deaths observed had been 1 in 30, the lowest (in England), 1 in 50 of the population. The highest rate of increase of population observed was in the United States, where the increase for a long period had been at the rate of 32 per cent every ten years. In England, it had been 16 per cent every ten years. In Sweden and England, the proportion of marriages, births and deaths had been progressively diminishing. The annual loss in population in England and Wales through emigration was 4,000 persons in 1820, 9,000 in 1827 and 30,000 in 1832. Part of this loss had been made up by immigrants from Ireland.

### The Electrical Society of London

In *Sturgeon's Annals* (1, 415) is an article directing attention to the Electrical Society of London, which had just been formed, and for which all subscriptions were to commence on May 16, 1837. Members within twenty miles of London were to pay two guineas, members living beyond that distance one guinea. The article was accompanied by a copy of the rules signed by the honorary secretary, Thomas Patrick, of 11 Lowther Arcade, Strand.

"It gives us great pleasure," said the writer of the article, "to learn that Electricity is no longer to be left to the isolated exertions of individuals, or the chance notice of learned societies. . . . The labours of the Astronomer, Geologist and Chemist will now have for their aid a Body ready to pursue with effect and vigour any line of investigation which mutual pursuits may suggest; and there will thus, we trust, be another of those enobling links of brotherhood, amongst mankind of all nations, drawing still closer the relationship of intellect."

### Royal Geographical Society

The seventh anniversary meeting of the Royal Geographical Society was held on May 16, 1837, Sir John Barrow, the president, being in the chair. In the course of his remarks, Barrow paid tributes to the memory of Horsburgh, Marsden, Murphy and Davidson, whose deaths within the last twelve months had been a great loss to science and the Society; referred with great satisfaction to the travels of Captain FitzRoy, Lieut. Wellsted, Dr. Andrew Smith, Major Mitchell and Colonel Chesney, and alluded to the expeditions then in progress under Back—who was exploring the coasts of North America—Alexander in South Africa and Schomburgh in British Guiana. He also spoke of Grey and Lushington who were due to sail in a few days for the coast of Western Australia, "with the hope of being able to penetrate some distance into the interior of that vast country and set at rest the question of the existence, or the contrary, of a great inland sea".

### The English Medical Profession

An editorial article in the issue of the *British Annals of Medicine* of May 19, 1837, contains the following remarks: "Besides many excellent anatomists this country possesses in Grant, Sharpey, Owen and others men who imitate the German physiologists and in their lectures take a large survey of the structures and phenomena of the organic kingdom in every stage of their development. Philosophical physiology is growing fashionable. Mr. Owen's lectures—clear, earnest, eloquent, beautifully illustrated—attract almost as many auditors to the theatre of the College of Surgeons as those of Cuvier did to the Garden of Plants in his best days. It is yet humiliating to reflect that England has not taken the initiative in those positive parts of medical science that have been cultivated with most success. In pathological anatomy our Hodgkins and Carswells were preceded by Dupuytren, Laennec, Cruveilhier, Andral and Louis; in physiology Treviranus, Burdaceh, Müller, Ehrenberg, Purkinje and Valentin had made immortal discoveries or written unrivalled works in the spirit of positive science before the new doctrines found an echo in our schools. . . . The ardent inquirer who wishes to devote himself to scientific investigations cannot count, as in Germany, on an asylum in the Universities; the endowments and fellowships of Oxford and Cambridge are the prey of rich, indolent men, and he is driven by necessity, as Liebig remarked, to serve Mammon. If a physician, he publishes a book upon new medicines, a treatise upon nervous affections, a book upon the diseases of females, or some other fortune-fraught theme, and is thus seduced, by corrupt institutions, from the path his genius might have illustrated under happier influences."

### The Paris to Brussels Railway

In the *Mechanics' Magazine* of May 20, 1837, it is stated that "The Railway which has long been projected for uniting the capitals of France and Belgium, at length bids fair to be commenced in good earnest. The king of the French has granted to Mr. John Cockerill the celebrated English iron-master of Liège, the 'concession' of the railway for fifty years. The French government is to advance 25 per cent of the cost on the distance from Paris to the Belgian frontier; and Mr. Cockerill is to be entitled to all tolls and profits for the first half century, when it is presumed, the works will become the property of the nation. . . . The terms of the concession were not agreed to until after the 'high contracting parties' Louis Philippe on one side and Mr. Cockerill on the other had had several interviews. The latter must be allowed to possess a most industrious spirit; he was a severe sufferer by the revolution in Belgium in 1830; and yet it seems is not deterred from adventuring his capital on a soil like that of France, which in fifty years may experience probably half as many revolutions."

John Cockerill (1799–1840) was the son of William Cockerill (1759–1832), the Lancashire mechanic who had worked first in Russia and then in Sweden before settling at Liège. It was John and his brothers Charles and James who founded the famous iron-works at Seraing, of which John became the sole proprietor in 1835.

## University Events

CAMBRIDGE.—The Adams Prize, offered every two years for an essay on some branch of pure mathematics, astronomy, or other branch of natural philosophy, value £246, has been awarded to Mr. W. V. D. Hodge, Pembroke College. Essays of great distinction were submitted by Mr. T. Groom, St. John's College, Dr. J. A. Todd, Trinity College, and Dr. P. Du Val, Trinity College.

At St. John's College, the following have been elected into fellowships: Dr. A. C. Offord, Keddey Fletcher-Warr Student in mathematics, University of London, 1934–37; F. Smithies, Wrangler and B, Part II, Mathematical Tripos, 1933, Baylis Student, 1934, Rayleigh Prize, 1935, Carnegie Fellow, 1935–37; R. A. Lyttleton, Clare College, Wrangler and B, Part II, Mathematical Tripos, 1933, Tyson Medal for Astronomy, 1933, Procter Fellow at Princeton University, 1935–37.

The Buildings Syndicate recommends that a site be assigned for the new Austin Wing of the Cavendish Laboratory.

C. C. Okell, of St. John's College, has been approved for the degree of Doctor of Science.

At Emmanuel College Dr. R. G. W. Norrish, professor of physical chemistry in the University, has been elected into a professorial fellowship.

It is proposed that a Mathematical Laboratory be constituted as a Department in the Faculty of Mathematics, that the head of the Department be the director of the Mathematical Laboratory, and that Prof. Lennard-Jones be appointed director of this Laboratory.

Proposals are before the University for the addition of metallurgy to the list of subjects which may be taken in Part II of the Natural Sciences Tripos.

MANCHESTER.—The resignation is announced of Prof. W. L. Bragg, since 1919 Langworthy professor of physics, who has built up in the University a school of research well known for its investigations of the solid state of matter. Prof. Bragg has been appointed director of the National Physical Laboratory (see p. 829).

## Societies and Academies

### Paris

**Academy of Sciences** (*C.R.*, **204**, 1049–1092, April 5).

CHARLES ACHARD, AUGUSTIN BOUTARIC and MLLE. PAULETTE BERTHIER: Researches on the viscosity of solutions of bile. Viscosity data from three specimens of ox bile in aqueous solutions at concentrations varying from 5 to 100 per cent, and discussion of the results applying the formulæ of Einstein and of Kunitz.

LUCIEN MALAVARD: The method of electrical analogies for the calculation of the wall corrections [of wind tunnels].

ETIENNE KONDOR: The Caquot theory of the equilibrium of soils.

MLLE. MARIE BLOCH: The spectrum of Nova Lacertæ 1936, slightly after the maximum brightness. Comparison of the spectra of Nova Lacertæ and Nova Herculis.

GEORGES ALLARD: An expression for the mean electrical density of a complex atom.

NY TSI-ZÉ and SHANG KENG-YI: The vibrations of plates of quartz cut in various planes around the optical axis of the crystal. The relations found by experiment between the angle starting with the Curie section and the frequency are given as curves.

THÉODORE V. IONESCU: Calculation with the aid of the quantum theory of the energy emitted by an antenna.

RENÉ FREYMANN: The two infra-red (OH) bands of the alcohols and the polyalcohols: molecular associations.

ANDRÉ MICHEL: The relations between the different solid solutions formed by ferrous sulphide.

LOUIS BOUCHET: The colloidal state caused by various specimens of zinc acting on some natural waters.

MICHEL CYMBOLISTE: The hardness of electrolytic chromium. The hardness varies with the current density, the temperature and the chromate concentration. Deposits of chromium, with hardness varying between 1,200 and 400 (Brinell), can be obtained at will by varying the above factors.

MAURICE GIRARD: The influence of the replacement of a hydrogen atom in the β position by a methyl group in phenyl-α-oxycrotonic acid.

PAUL CHOVIN: Researches on the Pechmann colouring matters. The synthesis of some colouring matters with unlike substituents.

VSÉVOLAD DE GOLOUBINOFF: Differential geochemical prospecting of mineral deposits.

VLADIMIR FROLOW: The analysis of the levels of Lake Ontario.

FRANTISEK LINK: Influence of the season and of the climate on astronomical refraction and the distribution of air masses.

ANDRÉ EICHHORN: Nuclear evolution and chromosome enumeration in *Begonia Pictaviensis*.

RENÉ VANDENDRIES: New views on the sexuality of the Basidiomycetes.

PIERRE CARRÈRE: Some metacercaria of *Atherina mochon*; the experimental development of a Gasterostomid.

CONSTANTIN DAWYDOFF: The Gastrodes of Indo-Chinese waters and some observations on their evolutionary cycle.

MICHEL POLONOVSKI, GASTON BIZARD and HENRI WARENBOURG: The action of insulin on the muscular glycogenolysis in the dog.

### Brussels

**Royal Academy** (*Bull. Classe Sci.*, **23**, No. 1, 1937).

L. GODEAUX: Some algebraic hyperspatial surfaces.

T. DE DONDER and MISS Y. DUPONT: New theory of the dynamics of continuous systems (4). Application to elastic bodies.

H. SCHOTS: The square of squares. To form a magic square for which all lines, diagonal and orthogonal, are bimagical, requires $64^2$ elements.

E. ANGLADE: Certain Laplacian sequences associated with a ruled surface.

R. GODEAU: Asymptotic lines and the equation of Lagrange.

S. DE BACKER: Viscous fluids and propagable waves.

J. P. BOSQUET: Propagation of acoustical energy in perfect fluids.

## Geneva

**Society of Physics and Natural History of Geneva, February 4.**

E. BRINER and E. PERROTTET: A method of analysis of very dilute ozone based on the catalytic action exercised by this gas in the oxidation of aldehydes. The method has the advantage that its sensibility increases with the dilution of the ozone.

AUG. LOMBARD: A new sheet of lower Cretaceous at Voirons (Préalpes externes, Haute-Savoie). The author describes a layer of fossiliferous limestones of Hauterivian-Barremian age situated in the Lucinge region at Voirons. This layer is connected with the lower series of sheets of the same age and of the same known facies at Hivernages, connected with the sheet of the external Préalpes. It helps to fix more exactly the limit of the autochthonous molasse of the ultra-Helvetic series drifted in the neighbourhood of Lucinge.

ARN. PICTET and MELLE A. FERRERO: A new factor for the agouti coat dissociated in the segregation of an interspecific crossing of guinea pigs. The authors have studied the genetics of the difference of coloration of the coat in a cross between the domestic and wild guinea pig. As the result of crossing, these two species can acquire new types of coat, previously non-existent in them. Moreover, when the same factor exists in the two species, its intensity increases in the descendants.

ARN. PICTET: The localization of the factors of heredity in ventral and dorsal areas. The author, after observing a mutation evident in the result of a crossing of wild and domestic albino guinea pigs, has been able to prove that the albino possesses in the latent state all the coloration factors and that it carries the same independent areas of variegation as the non-albinos studied. Hence the albino is a mosaic of dominant variegated areas invisible to the eye and albino areas.

## Rome

**Royal National Academy of the Lincei (*Atti*, 24, 3–43; 1936).**

M. DE FRANCHIS: Proof of the fundamental theorem on hyper-elliptical surfaces.

G. MARLETTA: Property of the second angle of Green.

B. CALDONAZZO: Ballast effects due to a couple of sources.

G. ARRIGHI: Oscillations about configurations which have motions of pure permanent rotation.

M. AIROLDI: *Pelagosite* as a member of a new genus of calcareous alga.

V. BAMBACIONI-MEZZETTI and A. SUARDI: First observations on the importance of cotyledons for the new formation of roots on hypocotyls of *Lupinus albus* L. and of *Vicia villosa* (Roth.).

G. GOIDÀNICH: Causes of the so-called vernal defoliation of the poplar in northern Italy.

G. DRAGONE-TESTI: Germination of the embryos of maize detached from the caryopsis and deprived of the scutellum in presence of polyoses containing fructo-furanose.

H. BYTINSKI-SALZ: Development of the tail in Amphibia (1). Experiments on isolation and defects.

E. PLATANIA: Nature of the peritrophic membrane of *Reticulitermes lucifugus* Rossi.

(*Atti*, 24, 45–97; 1936).

G. ROVERETO: Panoramic analysis in the geomorphical description of Liguria.

U. CASSINA: New graphical construction of the osculatory plane.

G. PALOZZI: Projective-differential geometry of new lattices of ordinary space.

G. BERNARDINI and D. BOCCIARELLI: Energy and intensity of groups of neutrons emitted by Po + Be (1).

G. CHARRIER and E. GHIGHI: Oxidation decomposition of 4-phenyl-1, 9-benzanthrone-10 with (1) a solution of chromic anhydride in acetic acid and (2) an alkaline solution of potassium permanganate.

E. GHIGHI: Decomposition of isodibenzanthrone (isoviolanthrone) by oxidation with an alkaline solution of potassium permanganate.

H. BYTINSKI-SALZ: Development of the tail in Amphibia (2). Changes of the correlations between the regions constituting the tail rudiment and the behaviour of the ectoderm of the caudal fin.

V. FAMIANI: Content of vitamin $B_1$ in grain compared with the international standard for the same vitamin.

A. SALVATORI: Chlorine content of the albino rat in relation to age.

## Vienna

**Academy of Sciences, January 28**

I. W. BREITENBACH and H. RUDORFER: Heat of polymerization of styrol in solution.

HANS STROUHAL: Zoological expedition to the Ionic Isles and the Peloponnesus (18). *Isopoda terrestria*: Armadillidiidæ, Armadillidæ.

HERMANN EICHLER: (1) New laws of colour indicators. (2) Catalytic synthesis of resazurin.

WERNER V. KOPPENFELS: Hypergeometric integral as a period of the quadrilateral representation.

FRANZ BUKATSCH: Influence of the thermal waters of Bad-Gastein on the assimilation of carbon dioxide by different water plants.

**February 18.**

ERWIN KAMPTNER: Inactive spores of marine coccolites.

ALFRED LEIMDÖRFER: Experimental study of the central regulation of the sugar in the blood.

M. PESTEMER and T. LANGER: Ultra-violet absorption of binary mixtures of liquids (10). The system benzene-heptane.

Z. HERRMANN and CH. SLONIM: Constituents of the Leclanché cell.

W. J. MÜLLER and JANET ZAPH BRIGGS: Theory of passivity (31). Passivity of chromium.

W. J. MÜLLER: Theory of corrosion (7). Relation between electrode potential, corrosion and corrosion passivity of metals in aqueous solution.

FRANZ WERNER: Data of fourth zoological expedition in the Ægean Archipelago.

VIKTOR PIETSCHMANN: New local form of *Cobitis tænia* L. (Cyprinoidea), *Cobitis tænia tesselatus*.

ANTON SKRABAL and ADOLF BERGER: Determination of the dissociation constant of hypochlorous acid by a kinetic method.

# Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

## Tuesday, May 18

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. E. S. Russell: "The History of Physiology: Ancient Biological Conceptions".*

GRESHAM COLLEGE, BASINGHALL ST., LONDON, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Studies of the Solar System" (succeeding lectures on May 19, 20 and 21).*

## Thursday, May 20

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Charles Singer: "The History of Physiology: The Emergence of Modern Physiological Doctrines to the End of the 18th Century, with Special Reference to the Growth of Views on the Circulation of the Blood" (succeeding lecture on May 21).*

CHEMICAL SOCIETY, at 8.—Discussion on "Synthesis and Stereochemistry of Condensed Alicyclic Systems" to be opened by Dr. R. P. Linstead.

## Friday, May 21

BEDSON CLUB, ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Sir John Russell, F.R.S.: "Chemistry in Modern Food Production".

# Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TWO EXAMINERS in the Aeronautical Inspection Directorate (Metallic Materials Section, Micrographic Sub-Section)—The Secretary (S.2.d.), Air Ministry, Adastral House, Kingsway, W.C.2 (May 17).

ASSISTANT AGRICULTURAL CHEMIST in the Kirton Agricultural Institute and Experimental Station, near Boston, Lincs.—The Principal (May 24).

ASSISTANT LECTURER IN MATHEMATICS in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (May 26).

LECTURER IN ENGINEERING in the Plymouth and Devonport Technical College—The Secretary for Education, Cobourg Street, Plymouth (May 29).

LECTURER IN MECHANICAL ENGINEERING in the Rutherford Technical College—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (May 29).

ASSISTANT LECTURER IN CHEMISTRY (and Botany or Zoology or Physics) in the Studley Horticultural and Agricultural College for Women—The Secretary (June 7).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Battersea Polytechnic, London, S.W.11—The Principal.

# Official Publications Received

## Great Britain and Ireland

Association of Special Libraries and Information Bureaux. Classified List of Annuals and Year Books. Supplementary to the ASLIB Book-List. Pp. 16. (London: Association of Special Libraries and Information Bureaux.) 3*s.* 6*d.* [164

Business Man's Guide to Management, 1937. 5th Annual edition. By G. E. Milward. Pp. xiv+120. (London: Management Library.) 5*s.* [164

The National Physical Laboratory. Report for the Year 1936. Pp. iv+144. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [194

Reports of the Council and Auditors of the Zoological Society of London for the Year 1936, prepared for the Annual General Meeting to be held on Thursday, April 29th, 1937. Pp. 79+4 plates. (London: Zoological Society of London.) [194

Manuring for Profitable Production: a Handbook for Farmers and Students. By Frank Ewart Corrie. Pp. 24. (London: British Glues and Chemicals, Ltd.) [194

First Report of the Alloy Steels Research Committee: Discussion-Correspondence and Committee's Reply. (Special Report No. 14a: Supplement to Special Report No. 14.) Pp. ii+25+1 plate. Second Report of the Steel Castings Research Committee: Discussion, Correspondence and Committee's Reply. (Special Report No. 15a: Supplement to Special Report No. 15.) Pp. ii+36. Seventh Report on the Heterogeneity of Steel Ingots. (Special Report No. 16.) Pp. viii+238+35 plates. The Work of the Coke Research Committees of the Iron and Steel Industrial Research Council. By E. C. Evans and J. M. Ridgion. (Special Report No. 17.) Pp. vi+62. (London: Iron and Steel Institute.) [194

The Zoological Society of Scotland. Popular Official Guide to the Scottish Zoological Park. By T. H. Gillespie. Eleventh edition. Pp. 120. (Edinburgh: Zoological Society of Scotland.) [234

Imperial Bureau of Plant Genetics (for Crops other than Herbage). An Outline of Cytological Technique for Plant Breeders. Pp. 16. (Cambridge: School of Agriculture.) 1*s.* 6*d.* [234

Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part 1: The Effect of Commercial Pasteurisation on the Nutritive Value of Milk, as determined by Laboratory Experiment. Pp. 67. (Reading: National Institute for Research in Dairying.) 2*s.* 6*d.* net. [234

Ministry of Labour. Report for the Year 1936. (Cmd. 5431.) Pp. vii+141. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [274

## Other Countries

Report of the First Scientific Expedition to Manchoukuo under the Leadership of Shigeyasu Tokunaga. Section 2, Part 3: Mesozoic Leptolepid Fishes from Jehol and Chientao, Manchuria, by Kazuo Saitô; Fossil Juglans from the Ku-Hsiang-Tung, Kirin, Manchoukuo, by Seidô Endô; On some Palæozoic Plants from the Southern Part of the Je-Ho Mountainland, Manchuria, by Isao Matuzawa; Geology and Petrography of Jehol, by Sutesô Satô. Pp. iii+23+8+25+xx+239+51 plates. Section 5, Division 1, Part 3: Arachnida of Jehol; Orders: Araneina and Opiliones. By Saburô Saitô. Pp. iv+88+11+4+33 plates. Section 5, Division 1, Part 6: Insecta of Jehol (2); Order Orthoptera (2). By Haruo Furukawa and Tokuichi Shiraki. Pp. iv+85+6+12+3+4+15 plates. (Tokyo: Waseda University.) [194

Sveriges Geologiska Undersökning. Ser. Aa, No. 180: Beskrivning till kartbladet Fårö. Av Henr. Munthe, J. Ernhold Hede och G. Lundquist. Pp. 82. 4.00 kr. Ser. C, No. 406: Om tertiära vedrester an Sequoia-typ i nordöstra Skånes kvartärformation. Av Tore Linnell. Pp. 24+2 plates. 1.00 kr. Ser. C, No. 407: Jordskalv i Sverige 1931–1935. Av K. E. Sahlström. Pp. 35+1 plate. 1.00 kr. Årsberättelse för år 1935. Pp. 9. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [194

Royal Alfred Observatory. Miscellaneous Publication No. 16: The Cyclone Season 1933–34 at Mauritius. By N. R. McCurdy. Pp. 7+50 plates. (Port Louis: Government Printer.) [204

Kungl. Svenska Vetenskapsakademiens Handlingar. Series 3, Band 16, No. 3: Die Sinusdrüse und der hormonal bedingte Farbwechsel der Crustaceen. Von Bertil Hanström. Pp. 99. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.) [234

Contributions to American Archæology. Vol. 3, Nos. 13–19. (Publication No. 456.) Pp. iii+231+24 plates. (Washington, D.C.: Carnegie Institution of Washington.) [264

Bulletin of the University of Wisconsin. Serial No. 2211 (General Series No. 1995): The University and Conservation of Wisconsin Wildlife. (Science Inquiry, Publication 3.) Pp. 39. (Madison, Wis.: University of Wisconsin.) [264

Scientific Reports of the Imperial Agricultural Research Institute, New Delhi (including the Report of the Sugarcane Expert, Coimbatore) for the Year ending June 30, 1936. Pp. v+140+7 plates. (Delhi: Manager of Publications.) 2.14 rupees; 5*s.* [264

Studies from the Connaught Laboratories, University of Toronto. Vol. 8, 1936. Pp. iv+51 papers. (Toronto: University of Toronto Press.) [264

The Rockefeller Foundation: a Review for 1936. By Raymond B. Fosdick. Pp. 58. (New York: Rockefeller Foundation.) [264

Exploration and Field-Work of the Smithsonian Institution in 1936. (Publication 3407.) Pp. iv+100. (Washington, D.C.: Smithsonian Institution.) [264

Newfoundland: Department of Natural Resources: Division of Fishery Research. Reports, Faunistic Series, No. 1: (1) Amphipods from Newfoundland Waters, with a Description of a New Species; (2) Decapod Larvæ from Newfoundland Waters. By Nancy Frost. Pp. 24. (St. John's: Department of Natural Resources.) [264

Contributions from the Department of Geology of Stanford University. Vol. 1, No. 4: The Pleistocene Fauna of Magdalena Bay, Lower California. By Eric Knight Jordan. Pp. iv+107–173+plates 17–19. 1.25 dollars. Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 7: A Resurrection and Revision of the Genus *Hiamea* Greene. By Ira L. Wiggins. Pp. ii+213–229+plate 20. (Stanford University, Calif.: Stanford University Press.) [264

Brooklyn Botanic Garden Record. Vol. 26, No. 2: Twenty-sixth Annual Report of the Brooklyn Botanic Garden, 1936. Pp. 148. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [274

American Philosophical Society. Library Annual Report for 1936. Pp. 26. (Philadelphia: American Philosophical Society.) [274

## Catalogues, etc.

A List of the Publications and Remainders of Bernard Quaritch, Ltd. Pp. 164. (London: Bernard Quaritch, Ltd.)

Zoologia Specialis enthält ein Angebot von Zeitschriften, Büchern und Monographien zum Teil aus dem Besitz des Prof. Dr. G. Grimpe und des in den Ruhestand getretenen Prof. Dr. L. Plate. (Antiquariatskatalog Nr. 711.) Pp. 184. (Leipzig: Gustav Fock, G.m.b.H.)

Old Medicine and Biology. (Caxton Head Bulletin 21.) Pp. 14. (London: James Tregaskis and Son.)

Catalogue of an Important Collection of Topographical Books and Manuscripts relating to the English Counties. (No. 212.) Pp. 68. (Leicester: Bernard Halliday.)